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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

Institute of British Foundrymen.

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Welsh Engineers' and Founders' Association.

Secretary: P. J. Griffiths, 20, Fisher Street, Swansea.

Retrospective 1924.

It is difficult to analyse the trade conditions which have existed in the foundry industry during 1924 because of its complex nature. Railway, automobile, and light castings foundries have been reasonably busy, whilst the foundries catering for the textile, metallurgical, shipbuilding, and electrical and mechanical engineering industries have been but poorly employed. The jobbing foundries have at times been busy, but the prices obtained have yielded but small and inadequate remuneration.

The British Empire Exhibition at Wembley showed many brilliant examples of the products of British foundries, and demonstrated to the world that the quality of British castings commands the highest respect.

The International Foundry Trade Exhibition was slightly smaller, but no less interesting, than the 1922 show. From an attendance point of view it undoubtedly suffered from the fact that the annual Conference of the Institute of British Foundrymen had been held just a week or two previously, and it is difficult for those in charge of manufacturing processes to leave their works at frequent periods. A strong desire has been expressed by foundrymen that foundry exhibitions should be held at such times and places that they do not detract from the attendance at the annual Institute Congress.

The Newcastle Convention added considerable lustre to the Institute's escutcheon. It was an ideal model upon which to build. Perhaps the only direction where improvement can be looked for is in the quantity of Papers offered and in the time allowed for their presentation and discussion.

The Institute has made very considerable progress, and its test-bar committee has produced a tentative specification for cast-iron which has very good prospects of being nationally, but a poor chance of being internationally, adopted.

The American, French, German, and Belgian foundry associations have devoted much time and thought to standardisation of castings, uniform costing systems, and the education of foundry personnel. Whilst the British have devoted a certain amount to these subjects, they are lagging behind other countries, and efforts must be made to tackle these questions on a constructive national basis.

It is gratifying to note the strong position of arrangement for the international exchange of technical foundry knowledge by means of Papers written by nationally acknowledged experts. This year the British had presented to them Papers by R. J. Anderson and Edward Boyd, of America, Professor Chevenard of France, and H. Van Aarst of Holland, whilst Professor Campion and Wesley Lambert and G. Hall have contributed to the proceedings of the French and American Associations. More than forty Papers by recognised experts have been contributed to international foundry literature since the system was inaugurated about four years ago.

During the year a new Branch—that of the Wales and Monmouth Branch—has been successfully launched, whilst Coventry, owing to inadequate local support, has closed down, and the majority of its members have joined the Birmingham Branch.

Two Branches have now attached to them very successful junior sections, that of Lancashire numbering already something like 230 adherents. This is a wonderful send-off for a new venture, and those responsible are to be congratulated. It seems to show that there is ample material ready and willing to adopt a live and progressive system of foundry education when the foundry employers can

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devise an adequate scheme and determine the conditions for its launching.

Up to now the Sheffield scheme, for which Professor Desch is largely responsible, is by far the best. If the foundry employers and Sheffield University could agree to the extension of this scheme and to render it a national one, then 1924, which has seen the creation of an excellent attempt to solve the foundry apprenticeship problem, would be counted in the future as an epoch-making one.

A marked change has taken place this year in the conduct and policy of the British Cast Iron Research Association. Not only has it gained in membership, but it has enhanced its reputation with the industry generally. A definitely progressive policy has been adopted and is being carried out to the satisfaction of the Department of Industrial and Scientific Research, its council and member-foundries. The only section where improvement could usefully be made is by the more thorough welding of the Associate members into the general body of the Association, or the elimination of this class of adherent, and their replacement by "Subscribers to the Library."

During the year a number of German innovations have been brought prominently to the notice of the foundry trade. One of them, Lanz pearlitic cast iron, has caused much useful attention to the "best possible" tests that can be expected from normal cast iron. Iron containing a maximum of combined carbon (*circa* 0.90 per cent.) obviously has a minimum in the graphitic form, and the quantity and distribution of this element basically controls the strength properties. Again, a minimum of foundry defects can be associated with bone- dry or heated moulds.

Of foundry equipment, the sand slinger, hydraulic moulding machines, jolt rammers, and pneumatic machines, and the plain strippers have all made considerable progress, and some good sales have been reported. Sand mills are now being constructed on much more scientific principles, and during the year several new designs have been evolved. Furnaces of all types, too, have received attention, and it is pleasing to note that better and more scientific drying furnaces are now available than were at the disposal of the foundry but a decade ago. In moulding practice, the general tendency to utilise a maximum of oil-sand cores in the construction of moulds has been emphasised.

Foundry raw materials are of higher quality than was the case but two or three years ago, and the practice of buying pig-iron from stock lists of quantities of material falling within certain analytical limits is increasing. Coke has not been so troublesome, and adequate supplies of material of unquestionable reliability have been consistently available. The behaviour of sands is better understood than formerly, but the principles of sand mixing are still not thoroughly grasped by the smaller foundries, and much remains to be done in this direction.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The Super-microscope.

To the Editor of THE FOUNDRY TRADE JOURNAL.

Sir,—May I trespass upon your space for the purpose of correcting a statement in the report of my demonstration of the super-microscope before the East Midlands Branch of the Institute of British Foundrymen? I refer to the paragraph which states that the effect of the "collector," which occupies a position behind the primary objective, is "to shorten tube length and working distance from 2 in. for 150 magnification to 5 to 6 in. for 75 magnification." The true rendering is as follows:—

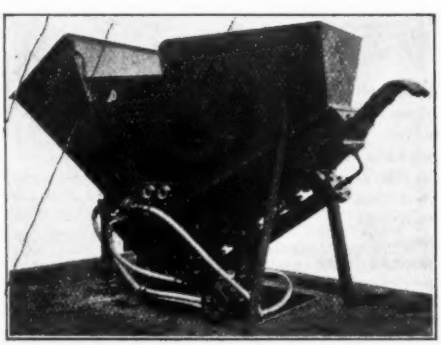
"One effect of the super-microscope system is the ability to employ for low-power observations variable magnification and variable working distance without altering the optical system." With high-power objectives there is, of course, only one critical working distance, no matter what system is employed, but the super-microscope permits of higher power being utilised than would be deemed advisable in the usual way, *e.g.*, critical photographs at X1000 with a ⅛-in. objective.—Yours, etc.,

F. DAVIDSON.

A New "Peebles" Sand Washer.

The annexed illustration shows a powerful new type of triple-jet "Peebles" sand-washing machine that has just been supplied by Messrs. Glenfield & Kennedy, Limited, of Kilmarnock, to the Liverpool Corporation Waterworks Department. It will wash a minimum of 12 tons of dirty sand from filter beds per hour, and up to 15 tons has been obtained on the tests, when supplied with water at only about 10 lbs. per sq. in. pressure and a very small quantity—at 40 lbs. per sq. in. pressure—for working a water motor forming part of the installation, the total weight of the machine being 28 cwt.

The operation of washing and cleaning sand from filter beds by hand, necessitating high-pressure water, has always been more or less unsatisfactory, and nearly three years ago Messrs. Glenfield & Kennedy, Limited, introduced the "Peebles" patent automatic sand-washing machine, of which the original smaller fixed and portable types merely require to be coupled up to water at only 3 to 5 lbs. per sq. in. pressure, available anywhere. All that is then necessary is to shovel the sand into the hopper of the machines, when it is spouted out continuously and automatically in a thoroughly clean condition at



NEW "PEEBLES" SAND WASHER.

the other end. These machines have found extensive application, and with water at 5 lbs. pressure will wash approximately 4.15 tons of sand (98 cub. ft.) per hour, using in this time 8,000 gallons of water, the stationary machine weighing 11 cwt. and the portable type 13 cwt.

The new machine illustrated works on the same principle except that it is larger and much more powerful, having three jets side by side. It is not easy to describe the action of the machine in a few words, but it is extremely simple and ingenious, consisting essentially of a water-motor-driven vibratory sieving device, and a series of hopper chambers, one behind the other on an inclined plane. Water is discharged upwards from the bottom of each hopper by a series of water jets, so arranged that the sand is thrown up into each chamber to a certain height, the dirt and impurities being washed out over gutters, whilst the heavier sand falls back again by gravity and passes on to the next chamber, the action being repeated. The cleaning effect is strongly assisted by the friction of one grain of sand on another during the rapid travel through the machine with numerous sharp turns at right-angles, and the sand is finally spouted forth continuously at the other end of the machine.

Catalogue Received.

Production Hardening of Taps.—Automatic and Electric Furnaces, Limited, of 173, Farringdon Road, London, E.C.1, are now circularising the trade with their Heat Treatment Bulletin No. 34, which describes some very satisfactory tests taken during a test run on a horizontal electric furnace fitted with a magnetic detector and working on the reheating of taps previous to quenching.

Cyanide Hardening.

BY C. H. S. T.

In the first attempt to case-carburise by means of a liquid carburiser the steel to be treated was probably immersed in a bath of molten cast iron, which is, of course, high in carbon. The difficulties encountered in this method were soon evident, and its use was discontinued. Subsequent study of liquid carburisers made the fact very evident that high melting-point solids must be dispensed with, and consequently salts that are capable of giving up carbon or nitrogen, and whose melting-points were not excessive, were used. Among these salts are the carbonates of sodium and potassium, and the cyanides of sodium and potassium. Fusible salts other than these have been used, but only to a limited extent.

There are several marked differences between case-hardening and liquid carburising. In the case-hardening operation the case produced is only superficial, though a prolonged immersion will eventually cause deeper penetration. The time required, however, is so excessive as to make such a method prohibitive, and the greatest case depth this method gives economically is rarely over 0.020 in. In these circumstances it is obvious that the depth of case desired is the determining factor as to whether liquid carburising can be successfully applied to any job. In addition to the very superficial case obtained, it has been found that the case does not taper off as gradually from the surface to the core as in box carburising, but that the line of demarcation is quite distinct. This means that cyanide hardened work has an extremely hard shell surrounding a softer core, which is not a wholly desirable condition on account of a tendency of the core and shell to separate.

Cyanide hardening is popular on account of the extreme surface hardness secured and the ease and shortness of time in which it can be carried out. The most important reasons for its use are the cleanliness of the hardened parts and the ease with which small parts may be hardened. There is no scale, and the surfaces are usually bright. For this last reason the final heating of carburised or case-hardened work is often done in cyanide or salt-bath mixtures. Steel, however, should never be case-carburised in a liquid carburiser unless resistance to shock, fatigue and impact is not essential, so that it is evident that by using a liquid carburiser some of the salient features of case-hardened steel are sacrificed. Where these qualities may be sacrificed, and extreme rigidity, cleanliness, and the maximum hardness are desired, cyanide hardening is ideal.

The salts most commonly used for liquid carburising are the cyanides of potassium and sodium, though some operators mix in soda ash and common salt with cyanide. Whatever salts are used, their action is essentially the same, and depends on the release of a gas which will give up its carbon or nitrogen to the steel. The basic principles of the pack hardening process and the liquid process are, therefore, the same.

Cyanide hardening may be accomplished in two ways: The piece to be hardened may be immersed in a bath of molten cyanide, or it may be sprinkled with a mixture of cyanide salts, then heated to the carburising temperature, and the sprinkling and heating repeated until the desired depth of case is attained. The latter method, known as cyanide varnishing, has some applications, but is not used to so great an extent as the immersion method, because it is not as efficient and is more complex.

In the immersion method, an open pot, rectangular or round, is suspended in a furnace and filled with the carburising salt. Some of the largest users of this process use a fused bath composed of 74 per cent. sodium cyanide and 26 per cent. sodium chloride; others use 33 per cent. sodium chloride, 33 per cent. sodium cyanide, and 34 per cent. sodium carbonate.

Cyanogen, a gas, the cyanide constituent of the salts, is gradually lost from the mixture, thus weakening it. As some cyanide baths are used more than others, and at different temperatures, it is found that there is a greater loss of the cyanogen in one case than in another. This, of course, lowers the hardening value of the bath, so that often when a hardener thinks he has a 74:26 mixture, in reality he has perhaps a 70:30 mixture. This condition has led to the adoption of the "Cyanamide" process, which consists essentially of the addition of a concentrated cyanogen salt to a less expensive vehicle salt, the addition of the cyanogen being made up when the bath is molten.

The temperature necessary for case-hardening by this method is very little over 730 deg. C., and case-hardening is successfully completed at temperatures from 785 deg. to 870 deg. C., though temperatures as high as 955 deg. C. are sometimes maintained. The higher temperatures are used for speed of operation, and also to heat just above the critical temperature of the original steel, so as to give the maximum refinement of core structure. High temperatures are, however, very detrimental to the containers. After the bath has reached the required temperature, the cold steel is immersed in the bath, and kept in it until the steel is thoroughly heated to the temperature of the bath. This requires from six to fifteen minutes, depending on the size and the amount of the work. Increasing the time of immersion increases the depth of the case. Quenching is usually done in either brine, water, lime water, or oil, immediately on removing the piece from the cyanide bath.

Distortion and warping is not excessive in this process if ordinary precautions are taken, such as rapid cooling and too long immersion or too high temperatures. The lag or elapsed time between withdrawal from the molten cyanide and quenching in the cooling liquid should be the minimum, especially on small parts.

Steel discs, washers, small screw parts, nuts, etc., are successfully hardened in cyanide where only a thin case is required, because there is less danger of carburising small or thin pieces all the way through when the cyanide method is used.

Molten cyanide is very injurious to most containers, and cast iron and steel last only a very short time when used for fused cyanides, because oxidation takes place very readily and holes burn through the container at unsound areas. It is quite common for the life of an iron or steel container to be as short as 50 hours, though sometimes they last 150 hours. Apart from the short life of the containers, the worst feature of their failure is that the molten cyanide leaks through into the furnace, where, if it is not noticed immediately, it ruins the firebrick lining and necessitates a shutdown for repairs to the furnace.

Aluminium Titanium as Deoxidisers.

Mr. George F. Comstock describes in the "Iron Age" some tests which were carried out in a steelworks to determine the relative efficiency of aluminium and titanium as deoxidisers of molten steel.

Summarising the facts brought out by this investigation, it has been shown that with acid electric steel heats, divided so as to eliminate the effect of accidental differences in composition or quality, the portions treated with titanium gave superior results in tensile tests, especially in ductility, as compared with similar portions treated with aluminium. The latter steel was found to contain inclusions of alumina, more or less segregated in groups, while the former contained slag inclusions which were in no case thickly segregated. The chief factor affecting the physical properties of the aluminium-treated steel was found to be the arrangement of the sulphide inclusions in curved streaks, which caused the tensile test specimens to crack before good ductility was shown. In the titanium-treated steel the sulphides were scattered irregularly in isolated globules and the microstructure was finer and more uniform.

THE British Schurmann Cupola and Foundry Equipment Company, Limited, has removed from St. Stephen's House, Westminster, to more commodious premises on the ground floor at 15, Victoria Street, Westminster, S.W.1. The telegraphic address is "Smeetolin, Sowest, London," and the telephone number, Victoria 9917. Mr. John A. Smeeton has been appointed managing director.

Trade Talk.

PROPOSALS FOR THE establishment of a pipe foundry on the East Moors, Cardiff, are well advanced.

A. E. PHILPOTT & COMPANY, engineers and merchants, 6, St. Stephen's Avenue, Bristol, have removed to 76, Victoria Street, Bristol.

LLOYDS IRONSTONE COMPANY, LIMITED, Princes Chambers, Corporation Street, Birmingham, have removed to Broad Street Chambers, Birmingham.

JAS. MILNE COOPER & COMPANY, LIMITED, 1, Cheapside, Bradford, are removing their offices and works on January 1 to Kobar Works, Ambler Street, Bradford.

GEORGE ELLISON, Perry Barr, Birmingham, have appointed Lt.-Col. F. W. Foster, late of the English Electric Company, Limited, manager of their branch office at Manchester.

SOME HUNDREDS of tons of the rail order recently placed by the Japanese railways were secured by the United States Steel Products Company. The bulk of the tonnage went to the de Wendel interests in France.

ANOTHER FURNACE was lighted by the Millom & Askam Hematite Iron Company, Limited, last week, and the Whitehaven Hematite Iron & Steel Company, Limited, intend to put a second furnace into blast before the end of the month.

THE MANCHESTER CITY COUNCIL have referred back to the Tramways Committee a proposal to place with the United States Steel Products Company an order for steel rails to the value of £1,800, which it was contended might have been more advantageously placed with a Sheffield firm. It was stated that only £85 was saved by placing the order abroad.

THE BOARD OF MANAGEMENT of the Royal Metal Trades Pension and Benevolent Society announce that there will be no contested election for the pensions granted by the Society, it having been resolved to admit, without ballot, all the accepted candidates on the list. Some 255 persons are now in receipt of the pension, and during the year about £7,000 has been distributed.

THE NEW monthly ascertainment price of Cumberland hematite pig-iron Bessemer mixed numbers is £4 12s. 0.2d. per ton, a decrease of 2.64d. as compared with the previous month's price. Under the existing arrangements the decrease is too small to justify any reduction in wages. The wages of the Cumberland iron ore miners will, therefore, during December, remain the same as last month.

AN ORDER for the delivery of some 20,000 tons of permanent way material, chiefly rails and sleepers, to Bulgaria is reported from Sofia to have been received in the face of very keen international competition by the sales organisation of Otto Wolff and the Eisen und Stahl Gesellschaft of Vienna. These firms represent the German Phœnix Steel Company, the Rheinische Stahlwerke, and the Fried. Krupp Company.

THE ASSOCIATED STEEL MAKERS are said, according to reports in the daily Press, to propose the supplying of steel for houses at specially low rates, while the London and North-Eastern Railway Company are considering the placing of the material in a low classification for transport charges. It is difficult to see how steel can be supplied at much lower prices than present quotations, which in most cases mean no profit or a loss to the maker.

FURTHER LARGE ORDERS are now being placed by the home railways, aggregating something like 5,000 wagons. The larger proportion is required for augmenting the resources of the London, Midland and Scottish Railway, the balance being a further instalment of the London and North-Eastern's programme. Complete particulars are not available, but so far as known the allocations are as follow: Metropolitan Company, Birmingham, 1,250 wagons; Midland Wagon Company, Birmingham, 750; Birmingham Wagon Company, 340; Craven's, Sheffield, 350; Motherwell Wagon Company, 500; S. J. Claye, Ltd., Long Eaton, 200; Butterley Company, 150; Clayton Wagon, Lincs., 150; Gloucester Wagon Company, 150; Hall, Lewis & Company, South Wales, 150; Stableford & Co., Coalville, 100; Derbyshire Wagon Company, 100.

THE WORK of raising the German Fleet, scuttled at Scapa Flow in June, 1919, is proceeding apace, and the first of the refloated ships has already left Scapa. She is the destroyer G 91, one of the 26 destroyers and two battleships ("Hindenburg" and "Seydlitz") purchased from the Admiralty in their sunken condition by Cox & Danks, Limited. She has been sold to T. W. Ward, Limited, Sheffield, for breaking-up purposes, and, it is expected, will be towed round to Inverkeithing, Firth of Forth. Already six of the destroyers have been raised, the last in the record time of 3½ days. Lifting operations have been suspended, but not, as has been stated, on account of the weather, but that the breaking-up work may be proceeded with at Lyness Pier, Scapa. Salvage operations will be started again in the first week of January.

Personal.

DR. ALEXANDER RUSSELL has been elected president of the Junior Institution of Engineers for the session 1924-25.

MAJOR J. L. BENTHALL, a special director at Sheffield of Vickers, Limited, in charge of the armour and allied departments, has been made a Freeman of the City of London.

MR. B. WALMSLEY, of Skeynes, Edenbridge, Kent, has joined the board of Bolckow, Vaughan & Company, Limited. He was for about 10 years chairman of the North Lincolnshire Iron Company, Limited, and for about 20 years a director of Redpath, Brown & Company, Limited.

MR. O. WASS, late of the Partington Steel and Iron Company, Limited, has been appointed Leeds and district representative for the General Refractories Company, Limited, Sheffield. Mr. Wass' father (Mr. H. Wass) was for many years general works manager at Partington, and before that at Messrs. Lysaghts, Scunthorpe, and at Round Oak.

Wills.

TAYLOR, P. B., of Middleton House, Briton Ferry, Glam., a director of Taylor & Sons, Limited, engineers £2,892

COATES, A. T., of Darlington, managing director of the Whessoe Foundry and Engineering Company, Limited £61,389

MOORHOUSE, S., of Norwood, Mellor Road, Ashton-under-Lyne, Lancs., a director of S. Moorhouse & Company, Limited, brassfounders and engineers £2,415

ESTLER, P. T. J., of Grasmere, Hainault Road, Chigwell, Essex, a founder of Estler Bros., engineers, Victoria Docks, Canning Town, E., and late of Dowgate Hill, Cannon Street, E.C. £5,971

Company News.

Joshua Buckton & Company, Limited.—Loss, £14,347.

Ebbw Vale Steel, Iron and Coal Company, Limited.—No interim dividend on preference shares.

Broughton Copper Company, Limited.—Interim dividend, 5 per cent. actual on ordinary shares.

Richard Hill & Company, Limited.—Profit, £2,232; brought in, £6,069; total, £8,301; dividend paid on preference, 6 per cent. per annum for half-year to March 31; dividend on preference, 6 per cent. per annum for half-year to September 30; forward, £2,901.

Cleveland Bridge and Engineering Company, Limited.—Gross profit, £43,372; net profit, £35,611; brought forward, £8,449; total, £44,060; dividend, 5 per cent., free of tax, on ordinary, making 7½ per cent., tax free, for year; reserve, £10,000; carried forward, £8,829.

Baldwins, Limited.—Gross profit, £493,520; debenture interest, sinking fund allocations, etc., £225,107; depreciation, £75,000; dividends for year on 5½ and 5 per cent. preference shares; surplus, £102,478; brought forward, £424,140; carry forward, £526,618; no dividend on ordinary shares.

Cannley Foundry Company, Limited, Writtle, near Chelmsford, Essex.—Capital £1,000 in £1 shares. Directors: C. C. Trew and Mrs. H. Trew.

Pashley & Trickett, Limited.—Capital £5,000 in £1 shares. Iron merchants. Directors: J. Pashley, 206, Meadowhead, Sheffield, and J. M. Trickett, 30, Newbould Lane, Sheffield.

T. H. Pickles & Sons, Limited, "Empress Foundry," Mytholmroyd, near Halifax.—Capital £10,000 in £1 shares (4,000 6 per cent. cumulative preference). Ironfounders. Directors: R. H. Pickles and F. T. Pickles.

Atholl Steel Houses, Limited, 207, Shettleston Road, Parkhead, Glasgow.—Capital £1,000, to carry on the business of builders of steel and other dwelling-houses. Subscribers: His Grace the Duke of Atholl and V. B. Stewart.

Rowe Brothers & Company (Bootle), Limited.—Capital £150,000 in £1 shares, to adopt an agreement with Rowe Brothers & Company, Limited, of Bootle, Lancs. Lead, copper, zinc, spelter and antimony smelters and refiners. Directors: C. A. Rowe, T. Belcher, H. C. Lancaster and C. Cookson.

MESSRS. JOHN A. SMEETON, LIMITED, have removed from St. Stephen's House to larger offices on the ground floor of 15, Victoria Street, Westminster, S.W.1. The new telegraphic address will be "Smeetolin, Sowest, London," and the new telephone number, Victoria 9917.

Some Further Reflections on Continental Foundry Methods.

By A. S. Beech, M.I.Brit.F., M.A.I.F. (*de France*).

(*Continued from page* 518.)

British Standard Axle Box.

Fig. 10 is interesting because it shows a typical example of what has been dealt with. It refers to the cope side of the lower half of the British standard axle box. Experience has shown that it is necessary to have the top part of this mould rammed on the soft side so as to permit the easy passage of gas. This is obtained by scooping out the sand over the top of the pattern before applying the pressure. The moulding here is also interesting; the pattern has deep vertical sides which require tight ramming in order to withstand the wash of metal.

Therefore the moulding box is placed into position on the machine, and is then filled up just above the pattern, then a wooden dummy—a rough outline in wood of the pattern—is placed into position, the pressure is then applied, the ram is lifted, the dummy block is extracted, and the box is filled again to the top of the sand-filler frame; the sand is then scooped out slightly over the top of the pattern and then the pressure is applied a second time.

This method, of course, is only necessary for deep moulds with vertical sides. On the loose piece by the side of the mould is a lug with an

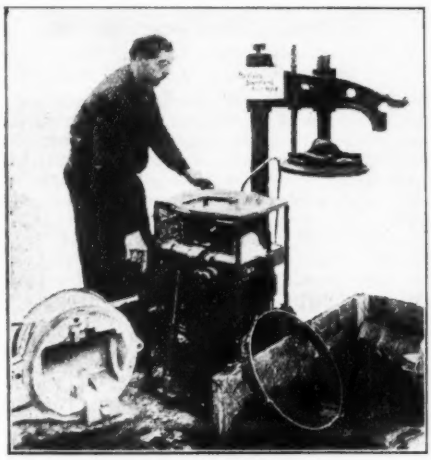


FIG. 10.—A MACHINE WORKING ON THE COPE SIDE OF THE BRITISH STANDARD AXLE BOX.

undercut: this undercut or projection has been rammed quite solidly by the machine, thus saving the core for this part. It will be evident that the jolt-ramming machine, or for that matter any power machine other than the squeeze type, will not ram under a projection, the squeeze-type machine being the only power machine which will accomplish this.

The machine in Fig. 10 is in the pattern-drawing position, that is to say, the lifting stools have been lifted and are supporting the stripping plate, the pattern plate being stationary on the table of the machine, thus showing the effect of the stripping plate clearly.

Fig. 11 shows the drag side of the lower half of the British standard axle box. The interesting points here are that this small roll-over machine has been swung around the trunnion of the machine by hydraulic power, and is in an upside-down position, with the mould drawn. The loose piece with the handle on follows the mould down whilst pattern drawing and is lifted off by hand; also the other loose-piece covering the slot-core is drawn in the same manner. Thus both the green-sand body-core and the slot-core are left green-sand in the mould with no danger of sticking to the pattern plate.

A further point to be noted is the small rib of sand going all round the pattern; this is drawn by means of the stripping plate shown. This stripping plate follows the mould downwards for about $\frac{3}{4}$ in. and then stops, as it is suspended right through the pattern plate by bolts on the

FIG. 11.—MAKING THE DRAG SIDE OF A BRITISH STANDARD AXLE BOX.

reverse side, which permit the stripping plate just to travel as far as is desired, and then to stop whilst the mould still descends, till the piston has finished its stroke. The mould is then lifted off, the loose pieces withdrawn by hand, a chamber oil-well core inserted, and the mould is then closed. This is a case where it is necessary to get the main green-sand core softer than the face

FIG. 12.—THE CORE BOXES FOR BRITISH STANDARD AXLE BOX (12-TON). ALL THESE BOXES ARE MADE BY A MOULDER. NO MACHINING.

of the mould, and this is accomplished by scooping out sand just above the part to be made softer.

Fig. 12 demonstrates the making of core-boxes. It will be noticed that they are composed of loose pieces enclosed by a shell piece. These are all

made in metal without machining, exactly as the pattern plates and stripping plates shown on the previous slides.

So far the Paper has briefly outlined the ordinary methods adopted on the Continent for ramming a mould, but it is felt that it would not be complete without a reference to what is known in France as "Rehausse Inferieure," or in Great Britain as "Down Sand Frame."

Down-Sand Frames.

It will be seen from Fig. 13 that the down-sand frame is supported on two small hydraulic cylinders or springs, and that this down-sand frame is slightly higher than the joint-line of the pattern plate, the actual distance between the pattern plate and the top of this down-sand-frame is arranged or decided according to the amount of sand necessary to secure the correct degree of ramming in the mould. When the actual distance has been determined, the down sand frame is fixed firmly and finally in the desired position, and the moulds will all be rammed by the ramming plate going down to the same level. With this application it is possible to arrange that the sand will be rammed as hard on the side of the moulding box as in the centre of the mould. This method helps in this case to getting this place harder; not only that, but the sides of this box can be sloped and made to such a shape that when the box is being rammed it gives lateral pressure on the sides of the pattern. The ramming under the bars, which usually are liable to give a soft spot, is ideal, as

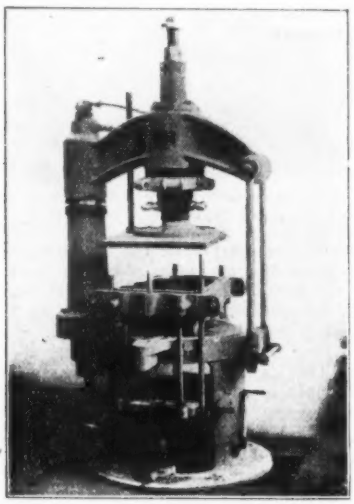


Fig. 13.—A Hydraulic Pressure Machine fitted with a Down-Sand Frame.

the box and the bars being pressed down in the sand, the bars themselves make the ramming under them. It is often the case that a bar of special shape can be made to ram sand into part of the pattern if necessary. The difficulty of ramming a barred box is done away with, as will be seen from Fig. 14, which shows the mould under pressure. It will be noted that the box pins are not on the pattern plate, but on the down sand frame; that the pressure plate, instead of going into the moulding box, as usually the case with the pressure machine, comes on the outside of the box.

The box is filled with sand, the pressure is applied which brings down the main ram, which presses the box, resting on the down sand frame, and also the down sand frame to the joint line, naturally overcoming the pressure exerted by the two smaller hydraulic pistons or springs.

The ramming here should be carefully noted; in the case shown on the screen it will be noted that the sides of the box slope upwards, so that one gets ramming on the face, ramming on the sides, and also ramming at the back. This method, however, is often applied with boxes with vertical sides.

Fig. 15 shows the pattern drawn and the mould lifted away; it will be evident that immediately the top pressure ram is placed at exhaust and starts to recede from the top of the moulding box, the two small hydraulic cylinders or springs supporting the down sand frame, and incidentally the moulding box, come into operation and start to raise the down sand frame and the mould away from the pattern, and the mould can then be lifted away.

This down-sand-frame method indicates a great stride in the process of pressure moulding machines and is particularly adaptable to repetition castings of a thin, deep, or shallow, and of an intricate nature.

Moreover, it must not be forgotten that the out-

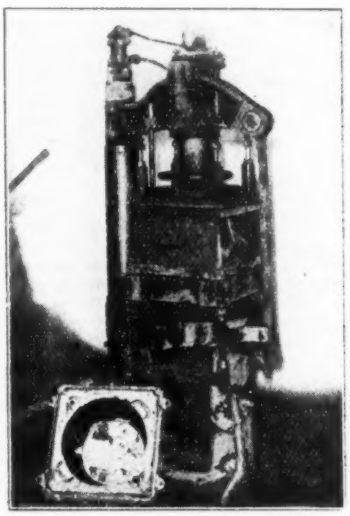


Fig. 14.—Illustrating the Method used for Ramming a Barred Box.

put of the machine is speeded up, because the separate action of drawing the pattern is eliminated, this pattern drawing having been accomplished on the exhaust stroke of the pressure piston by the action of smaller pistons underneath, as we have already seen, the actual ramming and pattern drawing only occupying a few seconds.

The speed of producing this mould is very interesting; two men with two machines produce a complete mould and close it ready for pouring every 1½ minutes. It must not be thought that

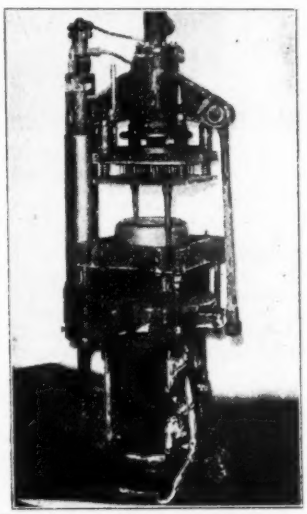


Fig. 15. — Making Casserole Castings on a Hydraulic Moulding Machine Fitted with a Down-Sand Frame.

the down-sand-frame is to be used in every case. The squeezing of moulds with the usual top frame gives perfect castings, and is to be used in most cases where work is to be changed regularly, as is usually the custom in Europe, where large repetition quantities of castings are not the rule. On the other hand, however, the down-sand-frame is to be recommended when a large quantity of castings of the same kind are required; for instance,

where barred moulding boxes of large sizes are required to be used—for example, large stove work. The cost of equipping the down sand frame is only justified in such cases, whilst in the ordinary work it may be more advantageous to use the ordinary methods.

Sand Considerations.

It has often been said in Great Britain that moulding sands are better on the Continent of Europe, especially in Belgium, than in Great Britain. The author hesitates to accept such a verdict, and thinks that any foundryman who has read Professor Boswell's book on "British Sands" will agree with him that our sand deposits are quite as good and quite as plentiful as those on the Continent. From Table I, which shows comparative

TABLE I.—*Comparisons of British Continental Moulding Sands.*

	Belgian yellow.	French red.	Mansfield.	Cornish red.	Billericay.
Silica ..	86.47	89.88	82.61	86.11	70.08
Alumina ..	4.96	3.29	4.96	5.29	22.30
Ferric oxide ..	2.58	2.23	0.97	2.45	4.28
Ferrous oxide..	0.29	0.25	0.30	0.29	0.46
Combined water	2.44	1.76	1.29	2.26	1.60
Free water ..	1.54	0.74	0.47	1.31	1.98
Lime	0.26	0.24	2.39	0.40	1.20
Soda	0.12	Tr.	0.10	—	—
Potash.. ..	0.47	0.64	2.20	0.95	—
Magnesia ..	0.37	0.24	1.56	0.47	Tr.

analyses of Belgian, French and British sands, it would appear that with some of our sands, at least, there does not appear to be any very great difference. It would follow, therefore, that if the venting properties of a certain sand were too low, that it should be an easy matter to add further silica sand to bring it more into line with the French red. Two analyses of silica sands are given in Table II.

TABLE II.—*Comparison of British and French Deposits of White Silica Sands.*

	Ryharsh.	French.
Silica	98.07	99.85
Alumina	1.10	0.10
Ferricoxide	0.13	0.03
Lime	0.15	—
Magnesia	Tr.	—
Alkalis	0.30	—
Manganese oxide	Tr.	—
Loss on ignition	—	—
Combined water	0.25	0.01

Sand Comparisons.

In foundries in this country it is very often the case that the moulding sand question is totally neglected, and if many moulders are asked how they expect to get cohesion or bond in their sand, they will say that they can obtain it by pouring water on the sand. The author has personally seen in many foundries sand almost in a "slush" condition through this practice. It is not too much to say that large numbers of bad castings and bad moulds come from this abominable practice. It is obvious that the damper the sand, the more steam will be produced when molten metal is poured into the mould, and, moreover, it is certain that the natural venting properties of the sand will not be so good as though the sand were kept on the dry side. When moulds are made by means of a machine, undoubtedly sand kept on the dry side is advisable, not only for the reason stated above, but also because the sand, when dry, flows better round the pattern. Hence, whether the mould is squeezed, jolted, or whether it is slung by mechanical means into the moulding box, there can be no question that the sand, when on the dry side, flows better round the pattern, and there is much less likelihood of uneven ramming than if the sand were damp. When damp sand is used it is quite easy to realise that cakes or solid masses of sand will form in various parts of the mould. Moreover, another difficulty arises when drawing the pattern, as the damp sand often causes the sand to adhere to the metal or wooden pattern-plate, and this either necessitates the repairing of the mould or breaking it and making a new one.

Another vital point in the fettling shop is that if the mould is damp and gases go through the skin of the casting, they cause roughness, scabs and holes which the fettling shop has to deal with. If sand is used on the dry side, the steam will not be generated to such a great extent, and in consequence cleaner castings are produced and less fettling is needed. Therefore, it is false economy to try and eliminate the proper preparation of the sand, because what is saved in the preparation of the sand not only makes very ugly castings, but also fettling costs are considerably increased, depending naturally upon the type of castings which are being made and how damp the sand has been.

Sand Preparation.

The main constituents of sand are generally silica, alumina or clay and oxide of iron and silt or dust and various alkalies. It may therefore be taken for granted that the bonding properties must come from the alumina and the oxide of iron, and, to state the matter generally, an ideal sand for moulding machines, or, for that matter, for hand moulding, is one which gives bonding properties, so that the mould made from it will be fairly rigid and withstand the inrush of the metal and conform to the shape of the pattern.

Further, it must be permeable, so that the gases generated in the mould either by steam or gases produced by the contact, or of the molten metal itself, can escape evenly all over the mould through the sand and not enter into the skin of the casting, or when the gases are of great volume or where there are congested parts of sand entering into vital parts of the casting itself.

If, therefore, it is determined initially that this is ideal sand, it will now be considered how such sand can be obtained.

Sand Milling.

Many British foundries which give attention to their sand have installed a machine very similar to a mortar mill with heavy rollers. The object of

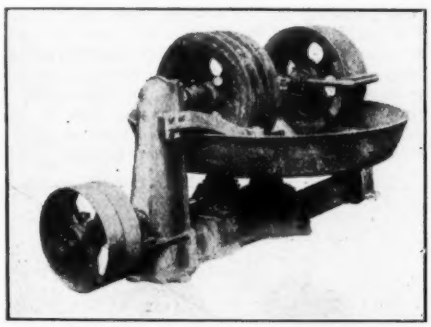


FIG. 16.—OLD TYPE OF CONTINENTAL SAND MILL.

milling sand at all is, of course, to coat with alumina and oxide of iron the silica grains and not to grind them.

If, therefore, the rollers are heavy and cumbersome the result obtained is, that although the bond may be obtained, the silica grains which are responsible for the venting properties of the sand are, to a great extent, lost. This is fatal, and in such a case it is frequently necessary to vent the mould all over with pricker wires.

To obtain correct preparation of sand, it must be borne in mind that the bond must be obtained and the grains of the sand must retain their natural shape as much as possible. To obtain this it is desirable to get a rubbing action on the sand and not a crushing action.

In many foundries, if a little specially good sand is required, the man treads the sand by a peculiar motion with his feet producing a rubbing action on to the sand in question, which gives excellent results. It is possible by means of a specially designed and constructed mill to obtain this very desirable result. It would be evident that it would be impossible in a busy foundry to tread all the facing sand required, so that mechanical means must be resorted to.

In the ordinary mill generally in use in this country the pan does not revolve, but only the mullers or wheels, and usually one of the wheels is of a peculiar construction, having teeth cut in it, but the author fails to appreciate the use of these

as they will hardly serve to cut up the cake of sand produced by the solid roller.

An outstanding advantage of some mills of this type is the bottom discharge. The author considers it necessary, in order to obtain a rubbing action of the sand, that both the pan and the rollers should revolve at different speeds.

The mill shown in Fig. 16 should give excellent results, because the rollers are on the light side in proportion to the size of the mill, and that in order to reduce the weight of these rollers, they have been hollowed out in the centre, just leaving a working face for contact with the sand. A further observation with regard to the mullers or

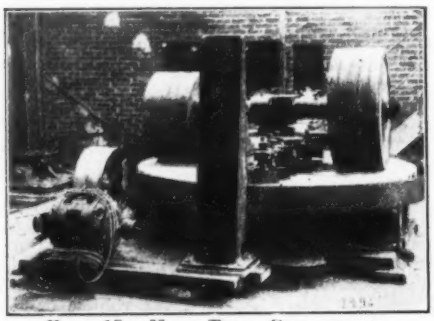


FIG. 17.—NEW TYPE CONTINENTAL SAND MILL (SMALL).

rollers is that one is corrugated all round which is much more likely to cut up into strips the cake of sand produced by the flat roller than the toothed wheel mentioned above.

With this mill both the pan and the rollers revolve at different speeds and in different directions, and the author claims that this will give a rubbing action corresponding as near as possible to the treading action of the man described.

The main trouble with this mill was that as the pan revolves and also the rollers, it was necessary to shovel all the sand out of the mill, which is a long proceeding and one which increases labour.

To eliminate this shovelling and also to obtain the desired rubbing effect, a new type of sand mill has recently been put on the Con-

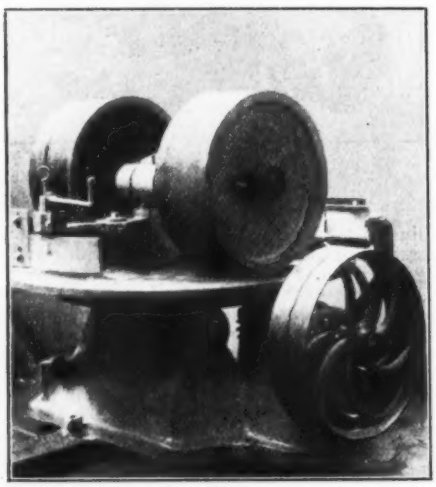


FIG. 18.—NEW TYPE CONTINENTAL SAND MILL (LARGE).

tinent of Europe. Fig. 17 shows the smaller type of mill. On a first glance, it would appear that, as the plate which takes the place of the pan is revolving at a fairly high speed, the sand would be thrown off. This, however, is not the case, as the guides which are shown on the slide keep the sand on the flat table.

The mullers or rollers are suspended about half an inch above the table and are driven by friction of the sand solely coming in between the plate and the rollers; consequently the sand grains are not being crushed, and silt or dust is not produced. After the sand has passed under each roller, the cake produced is cut up by the vertical blades placed in position after the roller.

To remove the sand from the table, the handle shown at the foreground is turned, and this opens the guide, and the sand is discharged automatically off the plate into a wheelbarrow, or it can be directed straight into a disintegrator, if the disintegrating of the sand is required. The table is supported underneath at three points containing revolving wheels, hence no inflexion of the table is obtained. The rollers are of a light nature and consequently it is thought that this is the first mill to give similar results to the old-fashioned treading of the sand together with an automatic and quick discharge that has yet been designed. The size of the table is approximately 5 ft. and approximately about 2 tons of facing sand per hour can be obtained from this mill.

Fig. 18 is a larger mill having about an 8-ft. table, and the action of this is somewhat similar to the smaller mill shown in Fig. 14, except that the mill can be set at will to give a required time for milling the sand and the discharge is automatic, without any turning of handles or any effort at all for the operator beyond placing the sand into the mill. The pan is replaced by a large

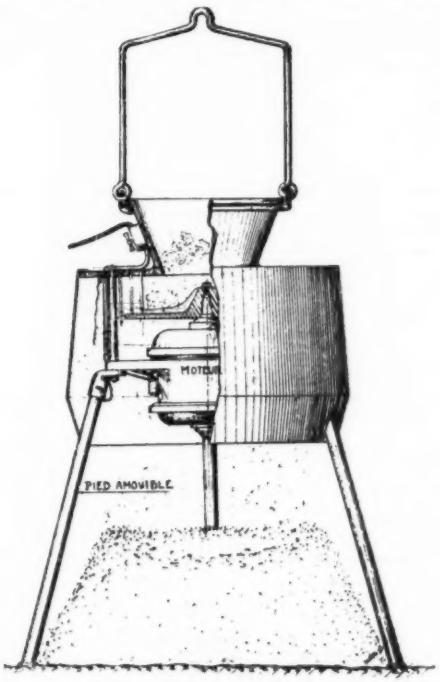


FIG. 19.—A NEW TYPE OF DISINTEGRATOR.

circular plate worked by a rotation movement. On this plate at intervals are placed three sets of cutting teeth made up of circular plates and concentric plates.

One of the rollers is nearer the centre than the other one, and by convenient scrapers the sand is automatically pushed towards the circumference of the plate, and eventually is discharged off the side of the plate. Hence it is a question of arranging the direction of the scrapers to give more or less milling to the sand as required. This mill is more efficiently used by feeding the sand on to the plate by means of a chute into the centre of the mill.

The amount of sand per hour from this machine ranges between 5 and 7 tons, depending on how long one desires to mill the sand.

Sand Disintegrating.

The type of disintegrator illustrated in Fig. 19 is entirely new, and is now gaining popularity in Europe because it is easy to repair and keep in order. The old-fashioned disintegrator has usually two rings of steel studs revolving in different directions at a very high speed. If a careless man throw into such a machine a "git," or piece of iron, something has to break, and it is usually the studs in these rings. This involves quite costly repairs, whilst the machine is generally out of action for many days.

This new type of disintegrator is very useful, because instead of rings, there have been substituted carpenter's nails, suspended by their heads. Underneath the nails is a plate with blades which revolve at a very high speed and throws the sand through the nails. If a piece of metal is thrown through, at the worst all that can happen is that a few nails will get bent or broken. These can easily be replaced in a very few moments at an extremely low cost and no time lost. The machine operates very well and the sand is disintegrated very efficiently.

In conclusion, the author feels that if the Paper helps any British foundryman to improve his practice to the profit of the British foundry trade, he will be more than rewarded for any effort he has put forward. The Paper shows clearly a few points at least that Britain may profit by and learn from the Continent, both as regards economy in working and saving of time in production. The author desires to acknowledge with many thanks the kindly assistance he has received from the following gentlemen: Mr. Primrose, of Messrs. the Grangemouth Iron Company, Limited, Falkirk; Mr. Phillips, of Messrs. the Austin Motor Company, Limited, Birmingham; Mr. T. F. Hardyman, of Messrs. Cylinder Castings, Limited, Derby; and finally, Monsieur Ronceray, of Soc. Anon. des Etabs. P.H. Bonvillain et E. Ronceray, of Choisy-le-Roi, France, for permission to show slides of their work and results obtained by them with the methods outlined in the Paper.

Preliminary Experiments on the Standardisation of Patterns.*

BY OSCAR QUERUT.

The author of this Paper, who has studied the question of standardisation in the American foundries, considers that the standardisation of patterns is intimately connected with that of cast machine parts, and that the latter investigation is still in the earliest stages. He concludes that it is necessary at first to limit standardisation to certain features that are common to all patterns. This question has been under examination in America for nearly two years, and the committee engaged on the task have begun by sending to most of the leading foundries a general questionnaire, accompanied by numerous suggestions designed to indicate in what form the desired information was required. The American committee has put forward three preliminary points: the method of construction for patterns and their distinctive symbols, the making of plate patterns and their adaptation for machine moulding, and the forms and dimensions of moulding boxes. If it is true that standardisation has been accomplished on certain parts of rolling stock the fact remains that the cast parts of general machinery and motors are not standardised in any way whatever.

Dealing briefly with these points as they arise it may be said that the method of construction embodies many features that can be standardised on particular lines. The programme must indicate the manner in which the piece is to be dealt with, the location and method of the various joints and partings, the form and size of prints, the methods for securing and removing loose pieces, the construction of core boxes. The application of standardised methods in the pattern shop will do much towards helping the maximum output of sound castings. Uniformity is attainable in dealing with the parting of moulds, and the rule should be that the pattern is sectionalised to correspond with each parting. Obviously there will be exceptions, but every effort should be made to conform to this rule. Proper sectionalising of the pattern greatly facilitates stripping: it is, therefore, one of the features of construction.

Taper.

The amount of taper, or draw, can be standardised by dividing patterns into two categories. For small pieces which can be stripped by man power a coefficient of 0.5 per cent. is suggested. For large castings withdrawn by mechanical means or for castings of large area 1 per cent. is proposed. Dowels can be standardised, and should be made of metal, especially for patterns from which a number of castings is to be made. The height of the dowel pin should be, it is suggested, twice its diameter. Dowels should be located near the outer surface of the pattern; alignment of the male and female parts of the dowel should receive special attention.

The question of battens or bracing may be standardised with regard to the sections employed which should be proportional to the volume of the pattern. The spacing of battens should be determined by the pressure that will result from the ramming of the mould.

Core Prints.

Core prints constitute probably the most important feature of a pattern, and special efforts should be made to introduce uniformity in this direction. Prints can be placed in three categories, top, bottom, and side. Top and bottom prints must be conical, and the angle of the cone is 8 deg.; this is the angle which allows clean withdrawal of the print, at the same time giving full support to the core. It is clear that the taper of these cores should start from the diameter of the core, which must also be the greatest diameter of the print. Side cores, too, have a taper of 8 deg. The thickness of core prints may be standardised to some extent; the thickness of a bottom print may vary inversely with the section of the core it is to receive; the top print should always be as thin as possible; the thickness of a side print is directly proportional to the length and section of the core.

Loose parts can be standardised in certain features. For instance, all parts in the upper box are provided with dowels. Loose parts on sliding faces can be attached either by dovetailing when the pattern is small and can be drawn by hand, or by wood screws when the pattern is large and requires to be drawn by a crane.

Fillets.

Fillets have always been treated empirically, and should receive special attention to attain uniformity. It is necessary to consider that the fillets are made in lengths, and must be fitted to the pattern; that the use of leather fillets is limited to intersections and to patterns of a high degree of accuracy from which only a small number of castings will be made; that where fillets are not definitely specified, the patternmaker will put them in, especially in corners that slide in the mould.

Strickle or striking boards offer promising features for standardisation. The direction of rotation is always in the same sense. The bevelled portion of the working edge is to be bevelled to 20 per cent. of the thickness when sand is being worked, and 10 per cent. when the material is loam.

Core Boxes.

In the construction of core boxes the following points are suggested for standardisation:—The box must always be made so that the tightening of the core corresponds with the direction in which it is placed in the mould. The body must, as far as possible, form a frame in which all the internal parts can be assembled and secured by external screw clamps. The battens which stiffen the frames must not be glued to them, but must be screwed in such a way that contraction or expansion can take place without distortion.

Where parts occur that are too delicate and intricate to be dealt with directly in the mould, special cores are employed. The part of the pattern corresponding to these must therefore be furnished with prints, the upper surface of which must be brought level with the nearest parting in the box.

Finally, there is the matter of painting the patterns. In the first place, it is obviously important to select distinctive colours to indicate the three principal metals, iron, steel, and bronze. Core prints would be indicated by the same colours, but taken in the reverse order. For surfaces that are to be machined it is proposed to mark them with some distinctive sign, such as a white star, which would not be so unsightly as three different colours.

* Extracted from a translation of a Paper presented to the 4th Annual Congress of the Association Technique de Fonderie.

Burning-on.

By J. H. LIST.

Burning is done more extensively in foundries to-day than perhaps is generally realised. The writer has had quite a large experience, and in this article proposes to give a few principles underlying the subject. Many foundrymen look upon this subject more as a joke, or a make-shift repair job. The writer read with interest the Paper given at the Newcastle Branch Institute of British Foundrymen,* October meeting, on this subject, and partly came to the conclusion that a burn-on, if successful, was a fluke, and at the best complimented each other on a wonderful undertaking. The writer insists that a burn-on is a practical method of saving a casting and also to show that it is an engineer's job when finished with, and that far from being a fluke a burn can be undertaken with a certainty as to success, because his record to date is 90 per cent. good.

Scope of Burning-on.

Burning is done for the following reasons:—(1) To make good a superficial fault on a casting; (2) to make good metal faults such as cold laps, miss-runs, short runs, etc.: (3) to make good brackets or parts of the casting which may have been knocked off in the shops or during transit, etc.; (4) to add parts that may have been forgotten to be cast on; and (5) to make good a casting which, although was cast correctly in the first place, requires an alteration.

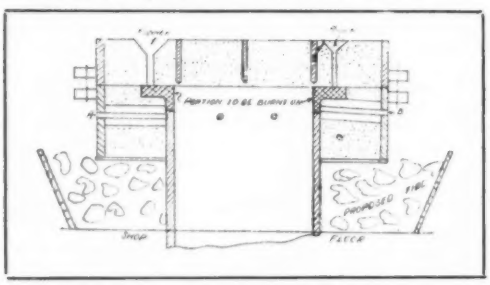


FIG. 1.

The general principle of burning-on consists of pouring molten metal over the parts to be repaired until they have fused together; this, in itself, appears to be a simple matter.

Basic Conditions.

The factors to be controlled are:—

(1) The surfaces must be perfectly clean, and particularly from dirt.

(2) The metal or alloy used to carry out the burn should in most cases be the same as the piece that is to be burnt.

(3) The metal to be used must be very hot.

(4) Sufficient metal must be run through the burn-in in order to effect a fusion.

(5) Sufficient head or surplus metal must be left on to ensure soundness; this will be removed in the machine shop or by dressing.

(6) The casting to be burnt must be slowly heated to redness for some distance round the burn by coke fires.

(7) Pouring must be continuous until a complete fusion has taken place. This should be tested by a wrought-iron rod about $\frac{1}{4}$ to $\frac{3}{8}$ in. dia. It will be noticed when complete fusion has arrived the rod will push through into the sand filling on the underside.

(8) When the job is finished the coke fire must be left over the burn, and allowed to die down slowly.

Governing Factors as to Possibility of Burning.

The factors to be considered before deciding to burn-on are:—

(1) Is the burn-on cheaper to carry out than the making of a new casting?

(2) What are the working conditions of the casting?

(3) Has the part which is to be burnt to be machined, because a burn-on is generally harder than the bulk of the material?

(4) Is the casting made up of fairly equal thickness?

(5) Owing perhaps to bad design, or through uneven sections, is the casting at present under heavy strains?

(6) Will the amount of metal that will be required to burn-on cost more to melt than the cost of making a new casting?

(7) If, of course, it is a question of urgency then the burn-on must be attempted despite the above reasons against it and it is for this reason that failures occur.

Making an Open Burn-on.

The case of a cold lap on a 20-in. bore pipe presents interest, and assuming it is 6 in. long running lengthways and 3 ft. from the end, that the pipe is $\frac{3}{4}$ in. thick normally with a flange at each end, then first test the walls of the pipe, exactly making the various thicknesses on the outside for about 2 ft. either side of the cold lap. If the metal is found to be even the coke fire may be made even, but in the case of the uneven pipe, and assuming $\frac{1}{2}$ in. metal is found at or near the cold lap running to 1 in. to the bottom, then without going any further, of course, if this pipe is for any considerable working pressure it would be best to scrap it without further thought; but for the purpose of this article the burning-on will be outlined. In setting the coke fire-place around this job it will be necessary to make the greater fire at the thick portion, because this would take the greater heat to make it red hot, and it is essential that expansion should take place evenly. It is important to start small fires and make them bigger as the day proceeds, so that heat is applied to the casting gently. One may take it that if the casting is made red hot and it has not cracked, the burn-on will be a success.

The fire-place can be made by placing old open grates around the cold lap, so as the fire is in contact with the pipe all round the area containing the cold lap. The inside of the pipe must be rammed up with sand and well vented, otherwise blowholes are liable to be left in the burn. Around the cold lap, leaving, say, $\frac{1}{2}$ in. clear space, make a bush or holder in loam and well vent this. This should be wired on to hold it in position. The depth of this holder should be about $1\frac{1}{2}$ in. above the highest point of the casting to be burned. An overflow should be arranged for, and to save iron should be so made that it flows into a spout which can be caught in a shank and can be used to pour certain moulds or to make lifters, etc. Not until the casting is red hot should it be burnt, and this with hot iron. Continue to pour on until complete fusion has taken place.

The contraction has to be even, and the thin part of the casting will cool first; therefore, it will be necessary to make up the fire larger on this side, taking the fire from the thicker part of the casting. The fire must burn out naturally, and next morning the job will normally be found to be sound. It is inadvisable to do a burn-on near a draught.

The Cracking of Burns.

Burns might be thought to be liable to cracking through the metal having to contract more than the red-hot pipe, but if the coke fire is built well over the top of the burn, after pouring is finished, the writer's experience is he has to encounter such a case.

Burning-on Boxed Work.

A boxed burn-on of a flange presents features of interest. This had been cast on out of truth and knock off. To save time in making another expensive casting a burn-on was attempted. Fig. 1 clearly shows how the job was accomplished. It is obvious that it is difficult to ascertain when fusion was effected, so apart from the overflow a series of outlets were arranged below the point of the actual burn-on, so that when the metal commenced to flow out of these there was proof of fusion. These, as well as the overflow, were then made up with balls of clay and the runner-bush filled up. No fire is necessary because the expansion and the contraction would be even, although if the writer had done the job he would have had a fire below as shown.

* See the Journal, November 13, page 425.

Notes on Manufacturing Costs.*

BY J. DE BOISGROLLIER.

There is now in France an extensive literature on the subject of prime costs and selling prices. The Belgian founders, too, have devoted special attention to these questions. The literature includes papers, pamphlets, and the reports of various societies, and there is available a great deal of useful information. Owing to the complexity of the problem of determining prime costs, it is necessary for every foundry to assist in the compiling of data. Matters will be forwarded by the adoption by writers of a general and comprehensive plan, but it remains essential for each foundry to adapt the methods to its own particular conditions. Before enumerating the determining factors, the difference between manufacturing cost and selling price must be clearly appreciated. Selling price, then, is the sum of four factors: manufacturing cost—obviously being the most important factor—transport costs, overhead charges, and return on the capital involved.

"Manufacturing costs" are confined to expenditure incurred up to delivery from the factory. No other supplementary charges can be included in this item if it is to be comparable in the final analysis; this condition excludes freight, dues and customs charges, items which vary with the distance and means of transport. Again, commission, discount, and similar items are not permissible as manufacturing costs. Finally, selling price must include the return on capital, interest charges, etc., items that vary with each transaction. It is not right, however, to say that the selling price is not a function of the manufacturing cost. Graphically speaking, it must embody and reflect the manufacturing cost. It is a mistake to allow agents to say that "iron castings of such and such a weight are worth so much." Representatives, too, should not make a concession in price in the customer's presence after a merely superficial examination of the casting. There is also the error of imagining that a certain line can be sold at cost because the profit can be made up from that of another line; in short, that the latter will pay for the former.

Danger of Quoting Average Prices.

There are dangers in "average" prices because the various items making up a price vary considerably, and the relative proportions may not always be the same. In order to avoid unpleasant surprises, the founder must not fix his selling price until he has minutely studied every item of his manufacturing costs. As an extreme example there is the founder who, because of competition, contents himself with vague approximations for manufacturing costs and bases his selling price on these false values. Without discrimination, he will accept difficult castings, leaving the easy ones to his competitors. By this means his works will be dealing with an undue proportion of awkward castings without the advantage of being able to make up for wasters, etc., by good orders for easy castings. The result will be that his prices for straightforward castings are too high and for awkward jobs too low, and the source of the errors is in the insufficient attention to prime costs. If accurate manufacturing costs are necessary to fix selling prices, they are even more important to the administrative staff who have to trace them step by step with a view to effecting economies as well as for the conformation to existing specifications and provision for future modifications.

Basic Conditions.

Three conditions are necessary to fix the manufacturing cost. First, the data must be exact and exhaustive. So far as is possible, averages and estimates must be eliminated; splitting up of items proportional to tonnage, man-handling, etc., so frequently practised, must not be done. Secondly, the methods adopted must be capable of immediate application, otherwise effective control becomes impossible. Thirdly, there must be a complete summary of the records which is available to all concerned; this summary may present a comprehensive view so that those using it may appreciate the value of the work of others as well as their own. It is to be understood that the same rules and principles are equally applicable to all cases. Indeed, it is in the foundry dealing with standard patterns as well as those of special design that the close examination of the factors making up the prime cost becomes so important and so complex. These principles can be applied no matter what the material may be—cast iron, steel, bronze, aluminium, or alloys, and as well for stock articles as for those of special design. Each item must be treated individually because of the considerable and sudden fluctuations in prices and rates that are such a feature of modern conditions. An outline only of the scientific and exhaustive methods of analysis laid down by the organisation can be dealt with here, and no time can be devoted to the synoptic tables and charts that have been drawn up. Every order, large or small, and independent of its scope, comprises four basic factors—the technical, commercial, administrative, and financial organisations. If undue prominence is given to any one of these sections to the detriment of the others, the final result will be erroneous. No hard-and-fast division can be made between the sections, and all overlap to some extent. For these notes, the administrative section is the most important, and it can be sub-divided into control of labour, supervision of shops, and the costing system.

Manufacturing costs depend on three subsections. Generally speaking, the first item is well looked after, but there is often a tendency to exaggerate its importance in relation to the second, which is frequently neglected in matters of detail. The danger in the costing system lies in confused co-ordination of the data, figures being adjusted without a full appreciation of their significance. Control of manufacturing cost must be able to operate, no matter what system of costing may be adopted. Existing costing systems are sufficiently elastic to accommodate themselves to new demands and conditions without drastic alterations. In order to exercise effective control of the manufacturing cost, it is advisable to make the costs records as well as the stores returns serve as supplementary books in the system, and not merely summaries, as such summaries will certainly be incomplete and inaccurate. It is not considered necessary for these records to be under two headings, debit and credit. It is found simpler to arrange them in columns, in which wasters and deliveries are entered as deductions and not as credits. By this means more elasticity is obtained and the successive adjustments are simplified; the tables are also easier to read—a not unimportant matter when they are to be placed before foremen and other members of the executive. It is advantageous to interest and educate these members in the appreciation of the numerous operations of which they perform a part; they also become conversant with the common or general expenses of the establishment, such as power, light, maintenance, handling, and supervision. The exclusion of averages, proportional charges, and similar vague values is insisted upon, since serious errors are introduced by these purely abstract factors. It is fatal to base results on data that are easily obtained under the plea of simplification; such figures are probably arrived at by arbitrary and empirical methods. There are, of course, some items which must be allotted by the central costing department, such as agents' fees and commissions and overhead charges; these cannot be dealt with by any direct method. The inclusion of these items might be expected to hinder arrival at the desired cost, but, thanks to their slight variation, the figures of the preceding period may be substituted provisionally. To be really effective, the cost figures of each piece must be available as the work progresses. This manufacturing cost must not only be regarded as a confirmation of the costing system, but also as combining technical records.

Method Advocated.

The starting-point is the record of the cost of raw material; the same applies to every department, finally leading to replenishment of the stores which have delivered material. Likewise, every operation is treated in sequence, each being entered on the record sheet which accompanies every piece. All material must be booked, and

* Translated from a Paper presented to the 4th Congress of the Association Technique de Fonderie.

the weight, quantity, and price must be initialled by those responsible for its use. These record sheets must be fully entered up to date and must keep pace with requirements. Each operation, too, must be duly recorded and initialled. By this means continual contact is maintained between costing system and workshop; indeed, the costing system may be regarded as an extension of the works organisation, and in some cases the two functions can be accommodated in the same office. For the purposes of records, manufacturing operations can be placed in two categories—those which work for longer or shorter periods on the same class of work or material, and those which deal with special orders. Those providing parts and materials for the shops may be referred to as "internal manufactures," and those which deal with outside orders as "direct manufactures." Those in the first class deal continuously with standard products, whilst the second class produces pieces that are essentially different and which cannot be confused with each other. It is just as important to obtain accurate costs for the one class as for the other. But in the standard products the records will extend over a considerable period, whereas in the second case each order must be taken individually, or, at least, on each group of orders. The "internal manufactures" include pattern shop, sand mixing, maintenance, power, etc., also the operation of melting either in cupola or crucible. With the exception of the last item, it may be said that these charges are unreliable, since the amounts are allotted proportionally according to weight or some other arbitrary factor; they are, in consequence, quite misleading. It is considered essential to obtain detailed costs of each item; for example, it is necessary to distinguish and apportion the various kinds of sand—green sand, dry sand, core sand and moulding sand. The determination of these prices must be made at short intervals in order to take into account the fluctuations of market prices in the raw materials. For power costs, it will be necessary to weigh or measure the consumption of each kind of fuel used, and to record the consumption of energy at each point. The proper proportion of the cost must then be allocated to each product, according to the hours during which energy has been consumed. Pattern costs can, in the majority of cases, be allocated directly to each order, and this applies equally to patterns for hand moulding and to those for machine moulding. This demand for detail may seem exaggerated, but if exact costs are required, the details must be analysed exhaustively. The principal difficulty lies in establishing the correct classification and definition, but, once made, they are applicable to all cases, and are continually repeated. The melting operation requires records of materials consumed, their weight and cost, all of which should be determined for every heat in order to obtain the cost of the molten iron in the ladle; costs for upkeep and drying of ladles and iron losses must also be included.

The question of "direct manufactures" is the cost of the actual moulding, which must be determined by the type, or for each piece if above a certain weight. Without going into every detail, it may be said that each item must be recorded in its proper sequence and as a definite figure without approximations. Careful and accurate weights must be taken of each piece and its risers, runners, heads, etc.; even, if possible, the weight of molten metal used. To arrive at accurate results, nothing can be ignored, nor can any proportional approximations be permitted; every material must be defined, every quantity weighed, and every operation examined and recorded. Even costs of inspection and storage are involved, and enough has been said to indicate the comprehensive nature of the inquiry and the minute attention to detail that is necessary to obtain reliable figures of actual costs. After all, it must be admitted that some proportional approximations must be made, no matter how far the process of sub-division may be carried, but a minute examination of each step will enable the technical and administrative staffs to effect economies. It must not be thought that to determine these costs a large and highly paid staff, such as could only be carried by the largest firms, is necessary. The question of reliable manufacturing costs is just as important to a small concern, and the matter should be examined as closely as is possible with the resources available.

A Note on Loam Boards.

BY J. E.

Many patternmakers do not know how to make loam boards correctly, and as many moulders do not know how to use them properly. This is not altogether surprising, because apprentices do not always get an opportunity of doing loam work, although many castings that are made in dry or green sand, from solid patterns, could be equally well made, and very much cheaper, in loam with sweeping boards. As a broad principle every cylindrical job should be considered as a possible loam job, although there are many cylindrical jobs which, because of cores or the number of branches, bosses and ribs, can be made more satisfactory with solid patterns. There is seldom enough discrimination shown in deciding whether work should be done in loam or dry sand. In some foundries loam moulding is favoured even for work for which it is obviously unsuitable.

When starting a loam job in the patternshop it is not often necessary, unless the design is very intricate, to set it down on the workshop drawing-board. It is usually sufficient to make the sweeping boards also the drawing boards. As much care should be taken in setting out the work on the boards as on an ordinary drawing board, marking and other allowances being carefully marked and coloured different from the finished metal thickness. The patternmaker really decides on the method of making a loam mould, although it does sometimes happen that a foundry does not use the boards supplied but gets out new boards that quite reverses the method of moulding which the patternmaker thought most suitable.

With regard to the thickness of the loam boards, they should never be less than ¾ in. thick and, with large boards, they may be as much as 1½ in. If sweeping boards, either for vertical or horizontal sweeping, are not absolutely rigid, good results cannot be obtained. This is more important even with vertical than horizontal boards, because the latter rest on trestles. In some shops it is thought that any timber is good enough for loam work, but this is a mistake. It is very seldom that the surface of the wood, as with patterns, is protected by paint, and while this may not be quite as necessary because only the edge of the board touches the mould, yet timber that has many wind shakes and is badly warped is not suitable for loam boards.

When a loam board is wide, it is a good practice either to insert battens or screw narrow battens across the surface. This may not matter so much in the case of a one-off job but, if many castings are required, it is important. With regard to the bevel 45 degs. is quite satisfactory, and the edge need not be more than ¼ in. With a very large job the edge may be ⅜ in. As to which side of a board should be bevelled much depends on the wishes of the moulder. In most cases the moulder prefers to pull the board with his left hand and apply the loam with his right, but this is not always so. With horizontal boards, of course, the top side is always the bevelled side.

Much time is often wasted in shaping loam boards. The quickest way, after the shape has been down, is to cut to the line at the bandsaw, gauge the edge thickness, and finish the bevel afterwards, first scraping the edge with chisel, gouge and spokeshave. When boards for a heavy job are going to be used several times it is advisable to fit hoop iron on the surface along the mould defining edge. If this is not done the loam soon wears the edge. Boards are often badly used in the foundry. When not required they are thrown into the open yard with disastrous results. It is surprising how few firms make use of loam boards, when they are finished with, for pattern construction, yet this is an economy that can well be practised without any expenditure of labour. It is different altogether from dissembling old patterns to obtain the timber.

High Tensile Cast Iron.*

By A. Marks, F.I.C., A.M.I.Mech.E., of Dudley.

The problem of improving the tensile strength of cast iron has engaged the attention of many workers. It was very early recognised that the excessive amount of graphite in cast iron, in which the flakes became interlocked one with the other, formed lines of weakness in the material which precluded any possibility of the material having a high-tensile strength. The early recognition of this fact led to many workers adding a material to the cast iron, namely, mild steel, which did not contain graphite, and which, therefore, acted as a diluent to the graphite and increased the tensile strength. The results, however, of adding increased amounts of steel did not show a consistent relation in increased tensile strength with increasing additions of steel, and the problem of later workers was chiefly in endeavouring to correlate the facts indicated in this way.

It soon became evident that increasing the additions of steel led to a hard and sluggish metal, and the practical limit was in many cases reached by the addition of 20 per cent. of steel. It is, however, easily possible to make additions of 50 per cent. of steel to pig-irons and still at the same time obtain a soft workable material which will readily flow. The strength of the early cast irons was of the order of 7 to 9 tons per sq. in., but immediately the question of regulating the graphite content of the iron was solved the strengths went up to the figures of the order of 10 to 14 tons per sq. in. The problem of adding steel to the pig-irons for the purpose of increasing the strength involves a knowledge of the working of the cupola and the composition of the pig-iron. Early workers tried the addition of steel by "rule-of-thumb" methods by a practical knowledge of the pig-iron, and very soon were into difficulties.

Their material has frequently been hopelessly at fault, hard and quite useless as a machinable product, the reason being that they had no realisation of the factors which it is necessary to take count of in making such a semi-steel. To carry a high percentage of steel it is necessary at the same time that the pig-iron should carry a high percentage of silicon, and also to melt the metal at a high temperature with a good coke ratio. Only thus can the economy of high-steel additions be taken advantage of, and a soft metal obtained. As a typical example of a charge of metal for a mixture containing 50 per cent. of steel one may take a high silicon No. 1 iron containing, say, 4.5 to 4 per cent. of silicon and 50 per cent. of steel, and obtain a soft machinable material using a coke ratio of the order of 1 to 6. The economy which is obtained when using the higher percentage of steel is, of course, nullified by the fact that a high silicon iron is necessary to accomplish this object, and, therefore, whilst it is easily possible to produce these high-percentage semi-steels, the economy of adding steel scrap is usually reached at a figure varying from 20 to 30 per cent., but it is quite a practical proposition to run these high-steel mixtures without getting hard iron. The tensile strength which will be obtained will not exceed figures of the order of 14 tons per sq. in., or 16 tons for thick castings of hard quality.

Influence of Section.

The problem of high-tensile cast iron is also involved with the question of section of metal. It is well known to practical foundrymen that a mixture of material which may be used for casting steam-engine cylinders and an average thickness of 1¼ in. would be quite unsuitable for casting, say, a steam engine liner of 2½ in. thickness throughout, and that the same mixture used for the two jobs would result in a very open-grained liner. Mixtures which are used for heavy castings of the type of a liner can be run either from very soft pigs or from hard pigs. In the case of the soft pigs the metal is able to carry much more steel and scrap additions, but in the case of the low-silicon irons increasing the tensile strength by the addition of steel is not possible to any great extent. For instance, one might run a steam-engine cylinder liner from a mixture of No. 4 and 5 irons and keep a tensile strength of 14 to 15 tons. An equally good liner can be made by running No. 1 iron with, say, 30 per cent. steel and 30 per cent. scrap, and this liner would come out with a tensile strength of the same order. Thus the graphite which is the chief factor in the tensile strength is adjusted in both mixtures (run in the same furnace) to a common factor, namely, the percentage of graphite, upon which the tensile strength of the iron largely depends. It is, however, quite common in the experience of foundrymen that certain types of pig-iron will carry more steel than others, even when the silicon content is the same in both irons. The variations in these irons will be found in the manganese and phosphorus contents, thus a high phosphorus iron will carry only small additions of steel before the mixture becomes hard, assuming the silicon content is constant, so that for the manufacture of high-percentage semi-steel mixtures it is necessary to use low-phosphorus irons or hematite pigs which will readily carry 50 per cent. of steel provided the silicon content is suitable. On the other hand, a high-phosphorus iron will not usually be satisfactory with more than 20 per cent. of steel for the same job. Again, when the section of the metal which has to be cast is considered, the amount of steel which can be added to increase the tensile strength by reducing the graphite content requires careful consideration. For example, if one is running 5-16-in. metal in a semi-steel mixture one may use either a hematite or high-phosphorus mixture, as in the last instance, but the amount of steel which can be carried would have to be considerably reduced, say, with a hematite metal, not more than 20 per cent. and a high-phosphorus metal with not more than 6 to 8 per cent., so that the economy of adding an increased percentage of steel can only be equated against the increased cost of the lower-phosphorus irons.

With a high-phosphorus iron the advantage of running thin sections is well known, and a small addition of steel of the order of 8 to 10 per cent. will very soon make one of these irons hard. Increased hardness, whilst giving an increased tensile strength, has a limit, and the upper limit of tensile strength of the mottled to white iron is of the order of 15 tons per sq. in.

Improving the Matrix.

Having considered the problem of increasing the tensile strength of irons by reducing the planes of graphite weakness, we next have to consider how, when the graphite has been reduced to the extent so as to leave a machinable iron, we can increase the strength of the ferrite matrix in which the graphite is embodied.

The increased strength of the ferrite matrix can be brought about by various means. The first is the elimination of impurities, such as phosphorus and sulphur. Both of these materials are hardening agents, but as the percentage increases brittleness comes in. For high-tensile cast iron, therefore, it is definitely necessary to eliminate phosphorus, involving increased cost, so that for all work, whether large or small, in which we require tensile strength above 14 to 16 tons it is necessary to remove the phosphorus content. The phosphorus content cannot be removed in the cupola, and hence one is forced to increase the cost by expenditure on high-class pig-iron. If this is quite in order, one can at once increase the toughness of the iron by the elimination of the phosphorus, but the tensile strength will only improve moderately. With no phosphorus present in castings the tensile strength comes out at the order of 14 to 16 tons, provided the graphite has also been simultaneously corrected. The elasticity as shown by the bending test, however, increases considerably.

The sulphur content, for similar reasons, it is necessary to reduce below 8 per cent., which involves the use of first-class coke in melting. The next

* A Paper read before the Wales and Monmouth Branch of the Institute of British Foundrymen, Mr. P. L. Gould presiding.

item, therefore, which is to be tackled in producing high-tensile cast iron is the question of the metallographic structure of the ferrite. In carrying out research work at the Swansea Technical College some years ago, investigating the possibility of producing malleable cast iron with the tensile strength of the order of 22 tons per sq. in. without the use of the annealing process, irons were made with a view to producing pearlitic structure or pearlitic cast iron. In these irons the weak graphite planes were reduced, and also the ferrite matrix strengthened by increasing the combined carbon, so that on cooling the structure consisted of pearlite and graphite. These irons were easily machinable in addition to having a higher tensile strength than the ordinary structure. On subsequent dates the work was carried out on a large scale.

Iron of this kind has been made on a large scale with a tensile strength of 19½ tons per sq. in. in thicknesses of sections of 1½ in. to 2 in. It is readily forgeable, and has considerable elasticity, about 0.3 per cent. elongation, and takes a permanent set on the bend-test machine.

The essential facts in producing pearlitic cast irons are: (1) It is necessary to reduce the graphite in quantity and size of flakes; (2) it is necessary to get the phosphorus down to practically negligible limits, as this induces weakness in the pearlite; and (3) it is necessary to adjust the silicon content of the iron so that the combined carbon in the finished casting is not excessive for the thickness of metal being cast.

FIG. 1.—PEARLITIC CAST IRON × 1,000. TENSILE, 19.5 TONS PER SQ. IN.

FIG. 2.—CENTRIFUGAL CAST IRON × 100. TENSILE, 20 TONS PER SQ. IN.

The percentage of combined carbon may vary between fairly wide limits. Pearlitic irons have been made with 0.55 to 0.89 percentage of combined carbon. A specimen of metal having a combined carbon of 0.56 per cent. exhibited under the microscope an all-perlitic structure at the high magnification of 600.

Additionally, slow cooling in the mould is essential to avoid chilling the job, hence the desirability of a hot mould; but this again is a function of the weight of metal to the weight of moulding sand, and not in itself a special factor, but only a relative one. Fig. 1 shows pearlitic iron at 1,000 magnification.

The production of pearlitic cast iron has been approached from different points of view. The German advocates of this material evidently attached chief importance to wear, whereas in England it has been approached on a large scale from the point of view of increased strength of the material and resistance to cracking when the material was subjected to high stress at a high temperature. It has been known for a long time that one of the strongest structures in steel was a pearlitic one, and, therefore, it was deduced that stronger irons would be produced by having an entirely pearlitic structure with graphite present as the only other constituent, and this graphite, as far as possible, should be as finely divided as possible. It is easily possible to produce the pearlitic structure providing the question of cost does not enter into the matter, but it is not easy to produce the graphite in an entirely non-flake or spheroidal form. The German patent does not make any attempt to control the form of the graphite. It is a question of commercial interest to know when it will be worth while to manufacture castings in pearlitic cast iron. In all cases where strength is the chief requirement, it will pay to ensure the increased cost of manufacturing castings in this material. For general purposes, however, where green sand and semi-dried sand castings are quite satisfactory there is no object to be attained in increasing the cost of production by introducing more expensive material. For rolls where high heat resistance is required, it will be extremely useful, but it still remains to be shown that its wearing qualities are higher than present rolls.

Lanz Pearlitic Cast Iron.

The essential point in the production of pearlitic cast iron is composition, and in a recent lecture at the London Branch* the lines upon which trials had been made were indicated. High temperature of the mould is also a desirable factor, and apparently in this respect the German patentees have drawn up an elaborate scheme for the control of the temperatures of the moulds, although it has been stated that the actual control could be, to a considerable extent, dropped after the workman concerned had gained experience in the application of these methods.

There can, of course, be no question of any mixture for the manufacture of cast iron being patented, and therefore the production of the pearlitic structure, in so far that it is not completely controlled by the composition of the metal, is covered by the process of heating the mould to definite temperatures. The German patent claims that the mould is heated to a certain definite temperature depending upon the mass of the material and other factors which are indicated. Now, it is quite a general practice in many foundries making special castings to return a dried mould, after having been partially cored up, to the stove for further heating, finally closing down the top of the mould and casting whilst it is at a fairly high temperature, so that apart from any further details which may be disclosed, there is nothing new in casting in a hot mould to anneal the metal. The manufacture of pearlitic cast iron in moulds which have received a double heating has been practised in this country.

The principal factor to attend to in the production of pearlitic cast iron is that of composition, and provided this is attended to with due regard to the thickness of the metal being cast, it is quite possible to produce pearlitic cast iron in reasonably dry warm moulds, regulating the cooling from the heat of the metal if there is sufficient mass of metal in relation to the mould.

The problem of high tensile strength cast irons, however, is one which for general practice is not of first importance. It is somewhat of less imme-

* See the Journal, October 16, page 327. "Pearlitic Cast Iron," by J. E. Hurst.

diate practical importance than the question of sand mixtures.

It is necessary that foundrymen should get rid of all unsoundness in castings. The troubles associated with foundry practice are more involved in moulding than with metal, and the metallurgical side of foundry work is well abreast of general moulding practice. This applies particularly in relation to the keeping back of dross and the breaking away of sand from the various cores, etc., during running.

Hence, for practical foundrymen it is essential to consider every way by which these defects may be removed from castings, as a casting with a test-bar strength of 18 or 19 tons per sq. in. is of little use if there is a junction of metal which holds a hollow due to trapped gas or a surface on which dross from metal or mould has been deposited.

The possibilities, however, when these defects are overcome, of pearlitic cast iron are many. Since its possible strength is high, and it will maintain its strength at temperatures of the order of 550 deg. C. over long periods, it becomes exceedingly useful material for special work, such as internal combustion engines. Further, its wearing qualities render it a good substitute for other bearing metals, and it is understood that it is being used without bronze bushes for wearing work in Germany. It may be a long time before pearlitic cast iron is used generally for a bearing metal, although in some of the cheaper motor vehicles ordinary cast iron, without bushes, is being used as direct bearing metal, and it would be a national economy for further development along these lines. Typical charges for various ordinary, special cast irons, and pearlitic cast irons were given.

The lecture was illustrated by some 30 lantern slides, and samples of pearlitic cast iron in mass and under the microscope at high magnification. The microphotographs, Figs. 1 and 2, show the comparison of pearlitic and centrifugal cast iron of approximately the same strength. The latter requires further annealing.

DISCUSSION.

A short discussion ensued, in which MR. JENKINS mentioned, in connection with semi-steel, that to make 50 per cent. steel with 4 per cent. silicon one must have very special iron, and with the ordinary foundry cupola 10 to 15 per cent. would be better. In making marine cylinders 4 to 5 tons in weight and 2 in. to 3 in. thick, if high tensile semi-steel was used one might reduce the section to 1½ in. or 2 in., which might serve some purposes, but as there is as much labour in moulding 1½ in. section as a 3 in. section the foundry owner would probably lose about 2 tons of metal. The idea of warming moulds was quite an old one, as the system had been practised in his apprenticeship days.

MR. MCCLELLAND asked whether it would not be far more beneficial to drive the metallurgical question home to the manufacturers of pig-iron, so that it could be branded in such a manner that the ordinary foundryman would be better able to grasp the class of metal he was dealing with.

MR. WILLIAMS asked whether it was considered that open or closed risers were better.

Answering a question raised by Mr. McLean as to 14-ton tensile strength high-phosphorus cast iron, MR. MARKS explained that there was no need to use steel at all for making castings up to 14 tons. tensile. Pig-iron and scrap can be used, but it is much more easy to adjust when steel is used than when buying high carbon pigs.

When making some crane parts Scotch iron No. 3 was used with 50 per cent. steel. This was easily machined, and would give 14 tons to the sq. in. There was no difficulty, providing the coke bed and coke charge were right, and the iron was run hot enough. If clean iron was required one should use high manganese.

Replying to MR. JENKINS, for ordinary foundries 2.0 per cent. silicon iron as used will not carry more than 10 to 15 per cent. steel, according to the percentage of phosphorus present. Hot metal was also necessary for the production of good castings from a fluid metal from which the dross would rise was obtained by means of high phosphorus metal. The author preferred open risers, but unfortunately dirt is more easily introduced, and the general tendency was for closed risers. The point was to get the gases away as quickly as possible. In casting pipes on end one had to open the mould at the bottom to the very limit in order to get rid of the gas.

MR. MARKS was of the opinion that not much could be gained by troubling the manufacturers of pig-iron, but as practical foundrymen, the material which the gods saw fit to give them must be used. If large quantities of pig-iron were required it was possible to obtain to specification, but if one knew the source of the supply there is no difficulty in getting the manufacturers to supply one with an analysis from which one can make up mixtures. It was frequently stated that it is difficult to run high phosphorus irons with hematite, but this has been done for many years.

Book Reviews.

Economics of Iron and Steel, by H. J. Skelton. (2nd edition.) Published by Stevens & Sons, Limited, of 119, Chancery Lane, and H. J. Stevens & Company, Limited, of Royal London House, Finsbury Square, London. Price 20s. net.

The first edition of this book was published in 1891, and has been the recognised standard work of reference ever since. In its revised form it forms a unique exposition of what the trade actually comprises.

There are very few people handling iron and steel who are familiar with every product marketed under this very wide classification. Those who are familiar with the material "semi-steel" have but the haziest notion of "skelp," and *vice versa*. Herein lies the exceptional value of the book—everything is dealt with in a reasonable and orthodox manner.

We have only one adverse criticism to make, and even that may be unjustified. The section dealing with the testing of castings does not include the tentative specification published by the Institute of British Foundrymen. The disclaimer we have thought wise to insert is on account of the fact that it has not yet been adopted by the British Engineering Standards Association. If the foundry trades consider themselves as part of the metallurgical industry of Great Britain, then they should, for their own benefit, possess the information rendered available by this book.

The book is divided into 35 chapters and contains about 680 pages. It is very well illustrated and indexed.

With very few additions, this book would serve remarkably well as a foundryman's handbook, and, in fact, so far as ferrous practice is concerned, "fills the bill" better than many books which are supposed to cater for this need.

Tales from the Gangway, by Pat Dwyer. Published by the Penton Publishing Company, Limited, 2, Caxton House, Westminster, London, S.W.1. Price 10s. post paid.

This book is a collection of 60 humorous stories, each one of which deals with a specific foundry problem. It is an American publication, and represents a method of imparting information which is foreign to the British mentality. Its reception by British foundrymen will be of a mixed character. It will be in one case very enthusiastic, and in another it will be wholeheartedly condemned. The reviewer, however, comes into the former category, for it allows him to study two interesting subjects simultaneously. The first is the mentality of the American jobbing foundryman, and the second his methods, which, so far as we can judge, are a replica of British practice. Though this book is of a definitely practical character, we specially recommend it to metallurgists—especially the "high-brow" variety—because no other book exists which paints such a true picture of foundry life. They will be able mentally to find scientific reasons and psychological explanations for working methods detailed. For the practical man, the book should be a source of pleasure, as it is bound to recall analogous conditions experienced.

The book contains 450 pages, and is illustrated both by humorous pictures and line drawings of foundry methods.

XUM

The Experimental Examination of Moulding Sand.*

BY AUGUSTE TAUFLIEB.

The scientific examination of moulding sands has been exhaustively treated, but the methods adopted are much too refined for everyday use in the foundry. The following notes indicate simple and direct experimental examinations that can be carried out in any foundry, at the same time giving definite and useful information on the quality and suitability of the various sands employed.

The chief characteristics on which the suitability of a moulding sand can be based are; the binding qualities or compressibility; permeability or porosity; and its resistance to mechanical stresses. For practical work in the foundry comparative results only are required, since it is usual to use a local sand if possible, and because the work turned out by each foundry is of a similar class, the requirements thus being covered by a comparatively small range of sand. Much instructive, if empirical, information can be gathered by recording the results obtained from various mixtures of sand. As a rule the examination of a sand consists in making some trials by decantation to determine the proportion of aluminium silicate in the sand. Sometimes a further test is made by applying a few drops of hydrochloric acid to a pinch of sand to indicate whether any chalk is present. For tests that will establish the most important points only the simplest apparatus is necessary, it can easily be "home made."

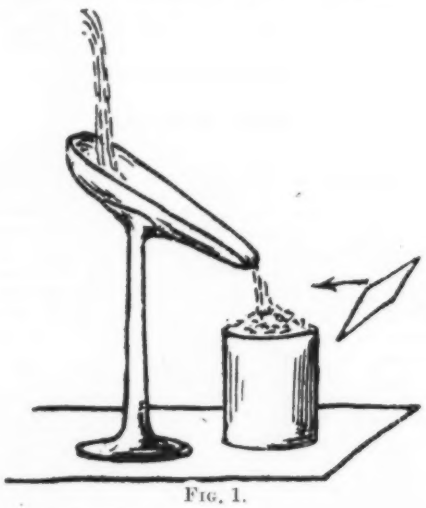


FIG. 1.

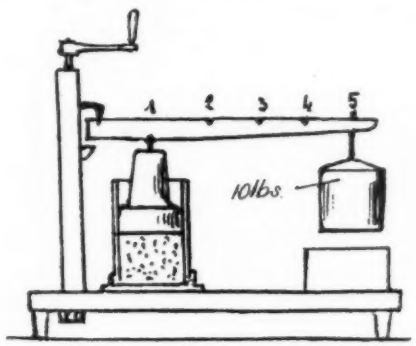


FIG. 3.

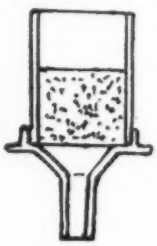


FIG. 4.

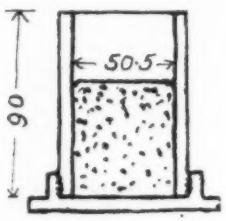


FIG. 2.

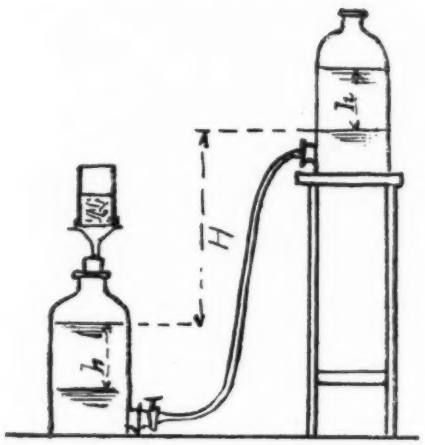


FIG. 6.

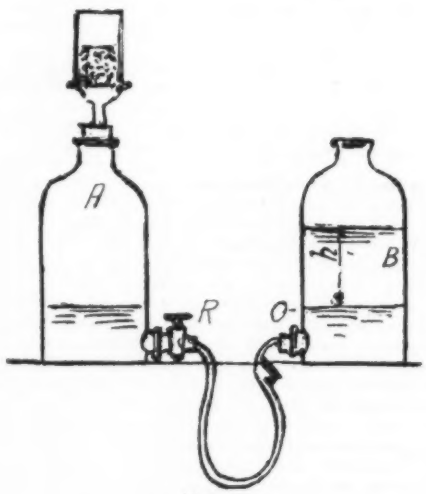


FIG. 5.

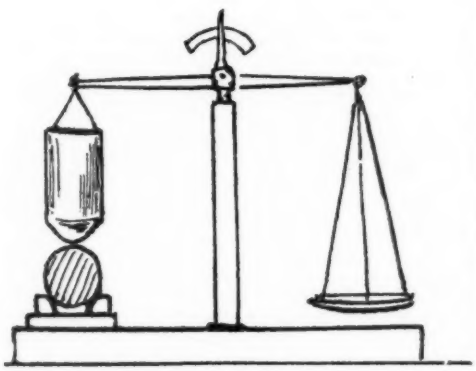


FIG. 7.

To examine a sample of new sand. After drying and crushing, the sample must be passed through a sieve of 90 or 100 mesh per linear inch —whichever size is adopted must be used throughout. A cylindrical measure is used for the sand; it must be filled without pressure or shaking. The best way is to fill it, as shown in Fig. 1; the

* Translated and extracted from a Paper presented to the 4th Annual Congress of the Association Technique de Fonderie.

excess being scraped off by a straight edge as sketched. The volume taken can be fixed at some specific amount, say 100 cub. ins. To determine the compressibility, the measured sample is put into a cylindrical vessel fitted with a movable plug, as shown in Fig. 2. A quantity of water equal to 15 per cent. of the volume is then added.

The sand and water are then mixed to ensure the same degree of humidity throughout and pressure is applied by means of the lever and weight, shown in Fig. 3. The lever is divided into five parts, and a weight of, say, 10 lbs. gives the pressure. The pressure varies according to which notch is occupied by the weight; as sketched, a pressure of 50 lbs. is exerted at the point 1.

If the area of the plug is, say, 3.5 sq. ins., then the pressure on the sample is just over 14 lbs. per square inch, which is an average figure for the pressure due to ramming. Smaller pressures are exerted by moving the weight into the notches nearer the sample. Permeability or porosity is determined by taking the time necessary for a measured volume of air to pass through the compressed sand. A series of readings should be taken with the air at different pressures. For this purpose the screwed base is removed from the container, Fig. 4, and its place is taken by the funnel shown. Two flasks are arranged on a level surface and connected by a tube, and the stem of the funnel passes through the cork of one flask; the arrangement is sketched at Fig. 5. Add water to the flasks up to level O; then measure on B the height from O, which will give the desired volume of air to be passed through the sand. Close cock R and add water in flask B up to the measured mark. Raise flask B to a height H, Fig. 6, which is the height of the water column necessary to give the desired pressure plus h, the depth of water necessary to displace the desired volume of air. It will be seen from Fig. 6, that the pressure at the beginning of the experiment is H+2h, and at the end of the test the pressure will be H. By taking the times necessary for the passing of the volume of air it is easy to calibrate the degrees of permeability of the sand. A necessary precaution is to have the connecting tube and the cock K of large bore, so that the resistance they offer to the passage of the water may not upset the accuracy of the result.

To obtain the third factor, the strength of cohesion or resistance to mechanical stress, the apparatus shown in Fig. 7 is required. It consists of a balance carrying a receptacle having a spherical bottom on one arm. The radius of the spherical base is about ⅝-in., and the vessel should be large enough to hold, say, 2 lbs. of duck shot. Under this vessel is placed the cylindrical core of sand, which has been rammed to the desired degree of hardness. Counterweights are placed in the scale pan until the spherical base just touches the sand core. The lead shot are now poured gently into the container until the sand core breaks down. The weight of shot necessary to crush the core is an indication of its resistance. To apply these tests to old sand, that is, sand ready for use and already moistened, it is enough to take a constant volume of sand which will give a test core of about 1½ in. long.

BRITISH ROPES, LIMITED, have entered into a contract to the value of £400,000 with Dorman, Long & Company, Limited, in connection with the new Sydney Harbour bridge.

A NEW CLUB HOUSE for the workmen of Vickers & International Combustion Engineering, Limited, at Barrow-in-Furness has been opened by the works manager, Mr. J. S. Snape, who occupied the chair. He gave a very appropriate speech, dealing with the benefits and formation of the Club, and mentioned the help and encouragement that had been so generously given by the firm.

THE DIRECTORS and sales representatives of the Associated Companies of Agricultural and General Engineers, Limited, were entertained at dinner on Monday by Mr. G. E. Rowland, the chairman of the company. Among those present were Brigadier-General Sir Henry Maybury, Sir William Tritton, Colonel F. Garrett, Major W. Paxman, Mr. T. L. Aveling, Mr. J. H. W. Pawlyn, Mr. J. E. S. Perkins, Mr. H. Carlisle, Mr. G. Locock, Mr. F. W. Griggs, Mr. C. W. Bryant, Captain H. R. Sankey, Mr. H. J. Burrell, Mr. G. M. Blackstone, Mr. D. O. Evans, and Mr. V. R. Garrett.

Gas Carburising.

While it is true that, in the strict sense of the term, any of the methods of carburising could be called "gas carburising," this term is commonly used to describe the method of carburising in which a gas is employed direct, and in which the steel to be carburised does not come in contact with a solid or liquid capable of giving up a carburising gas. All carburising is due, of course, to the action of gas, and it can readily be understood why a free carburising gas, such as coal gas, should have some industrial applications. Since it is true that carbon monoxide does the actual carburising, it is readily seen that any process which eliminates the reaction necessary for the production of CO during the operation, and supplies the gas direct, greatly simplifies the process.

The industrial process for carburising with gas consists essentially of a horizontal retort rotating in a combustion chamber fitted with suitable burner equipment for securing the proper temperature. The pieces to be carburised are charged into one end of the retort, which is then sealed, and discharged at the same end after a suitable time interval. Gas is forced into the retort under pressure, and, as the temperature is properly regulated, the steel absorbs the carbon from the coal gas very readily.

The same apparatus can be used with solid carbonaceous materials, replacing in part or wholly the carbonaceous gases. The types of parts which may be carburised by this method are practically unlimited. Special supports or frames are used for parts liable to sag under their own weight. The addition of solid carbonaceous materials acts as a cushion and prevents the marring of parts, such as threaded work. With this method, the same depth of case may be secured as with box carburising, but in a shorter time. Due to these and other factors, gas carburising is very economical in cost per pound of steel.

Foundry Queries.

Cast Iron Melting Pots.

(*Issue, December* 4, *Page* 480.)

"Miner" can ascribe the cause of the defect to either contraction or the job being moulded the wrong way up. I suggest it should be made in dry sand, using a spindle and board and cast by means of six round down-gates attached to the rim. This means, of course, the job would be cast in the service position. The dirt rises to the top of a casting, which in this case is the least important part. If cast to leave its own core the wall, which I presume is only 1 in. thick if the bottom is 2½ in. thick, will cool first and pull away from the bottom. It may be advisable to increase the thickness half-way down the pot gradually until it assumes 2½ in. at the base. The hardest iron obtainable should be used for casting it.

"WIDNES."

Cost of Lining Cupolas.

(*Issue, December* 11.)

The cost of lining the cupola you mention with firebricks in the ordinary way would be about £40, plus labour.

"DESPOND."

SIR ALFRED MOND has accepted nomination as one of the Government representatives on the board of the British Dyestuffs Corporation, Limited, in the place of Lord Ashfield, who has resigned his Government directorship on his election as chairman of the board of directors of the company.

THE COMPTOIR METALLURGIQUE LUXEMBOURGEOIS (Columeta), who act as sales agents for the Luxemburg Arbed concern and the Société Métallurgique des Terres Rouges, has established within the last year new agencies or branches at Milan, Lisbon, Constantinople, Athens, Helsingfors, Reval, Cairo, Alexandria, Beyrouth, Havana, Manilla, Valparaiso, Lima and Tokio.

Construction of a Special Furnace Blower.*

BY "CELSIAN."

Probably the most disappointing feature experienced when consulting articles published on the design of small furnaces is the absence of details on how to make provision for an efficient draught of air.

Most descriptions deal with furnace construction exclusively, and in many cases no mention is even made of the blowing arrangement. Enquirers are usually referred to price lists, wherein fans, driven by electric or water power, are described. A substitute for electric blowing arrangements is the ordinary "foot blower," which possesses the great disadvantage of requiring continued labour throughout the operations, apart from producing an unsteady pressure. No one is better able to verify these facts than the practical amateur himself, and extensive experience has proved that unless a cheap and efficient means of producing an unlimited supply of air can be secured the scope for experimental melting is extremely limited. The blowing arrangement detailed in Fig. 1 works continuously, and requires very little attention. It is simply constructed, and with the exception of varying lengths of rubber or flexible steel tubing, costs only a few shillings to complete.

Construction.

Two large rectangular boxes (preferably 18 in. × 18 in. × 18 in.), provided with air-tight lids, are first secured.

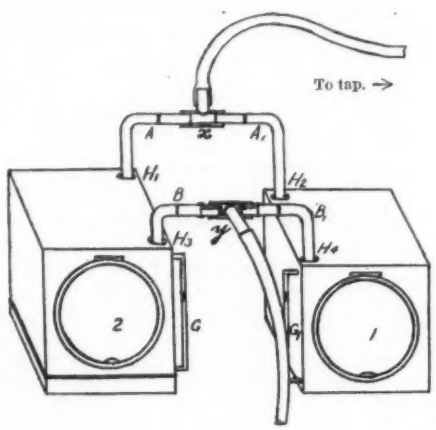


FIG. 1.

It is essential that when the lids are closed no air should be able to make egress or ingress, and as a preventative the hinges of the lids should be well coated with vaseline or petroleum jelly. Any other leakages are easily remedied by soldering. Two holes, ½ in. dia., are made in each of the boxes at the points H_1, H_2, H_3, H_4.

Probably the simplest method of opening up a hole in a tin box is with the aid of a "tin opener," as drilling usually causes indentations to form on the surrounding metal.

The pipes A, A_1, and B, B_1 are ordinary ½-in. lead gas pipes bent at right angles, with one end soldered into the holes provided for them in the boxes. Packing with sand is recommended when bending the pipes, so that no flattening or distortion occurs at the angles. The soldering is accomplished by thrusting the pipe about ¼ in. down the hole, flattening out the protruding portion against the under side of the roof of the box, and then applying solder on the top. To prevent hot air returning from the furnace and melting the lead piping, when either of the lids are opened to remove the accumulated water, a simply constructed non-return valve is attached to each air pipe at *y*. A small disc of lead—the same diameter as the external diameter of the lead pipe is cut from a sheet, and a similar disc of fine leather also secured, when both are firmly attached by sewing with a strong needle and thread.

* This article has reference to "Construction of a Small Steel Furnace," which appeared in our issue of November 27.

Two of these lead and leather discs are prepared, after which a small hole is punched towards one side with a needle. An ordinary pin is forced into each of the pipes at the points *p* and *q* (Fig. 2), and solder added to keep the tubes air-tight. One end of a fine brass spiral spring is attached to the pin, and the other end fixed through the hole in the disc lying loosely in the T-piece, so that the disc is firmly held to the mouth of the pipe. A small globule of solder is placed at the bottom of the T-piece, close to but not touching the disc, and allowed to solidify. When air passes to the furnace it thrusts back the top of the little discs, but when no pressure or a return pressure is exerted it falls back to its place.

The open ends of the pipes are soldered to the cast-iron T-pieces *x* and *y* respectively. It will be noted from Fig. 1 that the open end of the T-piece *y* extends horizontally from the pipes, where it

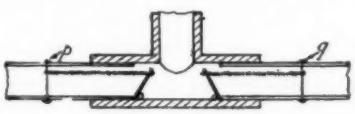


FIG. 2.

is then connected directly by flexible steel tubing to the furnace. The open end of *x is vertical*, and is connected by rubber tubing to a water tap.

The gauges G, G_1 consist of a 16-in. length of ¼ in bore glass tubing, which is loosely fitted to two right-angled pieces of ¼-in. lead pipe. The arms of the pipe are ½-in. long, so that the gauges extend almost the whole length of the boxes. The open ends of these small pipes are soldered to ¼-in. holes in the sides of the boxes in the same manner as previously described. Before soldering in these angle pipes a useful addition to the gauge is a small float in the form of a coloured cylinder of wood (about, say, $\frac{3}{16}$-in. in length, and thin enough to float up and down the tube with ease).

The glass tubing is firmly fixed to the lead pipe by packing with thread and covering the whole with a "blob" of sealing wax.

A block of wood of suitable size is placed under the box 2, and the whole is then ready for working.

Manipulation.

The most convenient place for the large majority of furnace operations or founding on the small scale is an outbuilding with water laid on. A stone floor and surroundings do not lend themselves to conflagration.

The most suitable place for the blowing apparatus is a wash tub. When placed in the tub a rubber tube is connected from the open end of *x* to the tap, and a flexible iron pipe from *y* to the furnace. The inflowing water dispels the air which is directly led to the furnace, the pressure being controlled by means of the water tap.

When the box 1 has filled with water the second one is only about three-quarters full, and therefore the danger of water entering the air pipe is negligible, since it gives the operator time to empty 1 before any action of this nature can take place.

By opening lid 1 the water is emptied, but the air pressure is undiminished, since the water pressure entering 2 is unaltered, although the liquid is only entering one box.

The stop-valves prevent any "back-rush" of air from the furnace to the box.

All parts are tested under water pressure to see that they are water-tight, to ensure the maximum pressure being obtained, and thereby allow a large range of different air pressures to be used. Safety arrangements can be placed on top of the upper side of box 2 to avoid any danger of water passing up into the air tube in the event of an overflow, and also for letting the operator know (by means of a sound) that it is time to empty the water.

These are not to be recommended, however, as they consist of spring clasps which weaken as time elapses, and thus allow a leakage of air, obviously reducing the amount of available pressure. If carefully dealt with, this blower will leave little to be desired, as it requires few repairs and seldom goes out of working order.

Institute of British Foundrymen.

NEWCASTLE BRANCH.

A meeting was held in the Neville Hall on Saturday, November 29, Mr. J. W. Frier (Branch-President) presiding.

A Paper entitled "Drawing and its Relation to the Foundry" was read by Mr. M. E. Gallon (Past-President), of Dunston-on-Tyne, the lecture being illustrated by lantern slides.

The President announced that the annual dinner would be held on January 24 instead of on January 17, and that the Junior Section was holding a smoking concert on December 12, and he hoped that the Senior Section would help.

Mr. Gallon was then called upon to read his Paper.

Drawing and its Relation to the Foundry.

MR. GALLON, after emphasising the necessity for every moulder to construct a presentable drawing, said he believed his lecture was the first attempt to bring up the matter for discussion. That being so, he made his remarks as elementary as possible, and expressed the hope that more advanced lectures would follow.

"Freehand drawing," said Mr. Gallon, "is necessary to the loam moulder, for he has many calls upon him for this class of drawing when he is marking off tackle on the bed." After a man has achieved proficiency at freehand, then the lecturer suggested that he should learn plane and solid geometry. Finally, a study of perspective drawing should be undertaken. For a moulder to excel at his craft he must go still farther, and learn machine drawing and construction. Whilst prints of finished engines do not normally enter the foundry, the component parts of machines are handled daily, and a better conception of the underlying principles of the machine helps the moulder to visualise the essentials of the components. That is where soundness is necessary, and where strength is required.

The inability of a moulder to sketch was illustrated by an actual drawing of a pillar discovered amongst waste paper. The same drawing had been copied by a high-class loam moulder and a good draughtsman.

To illustrate geometric drawing the lecturer had prepared a slide, taking the subject from the dividing of a line into a number of equal parts up to the illustration of hexagonal prisms.

The picture plane was given as an illustration of perspective, and from it the lecturer developed views of a cube and square prism. Finally, the author dealt with machine drawing, and gave as examples an eccentric and an eccentric strap in position; a globe valve casting; a Kingston valve, and a ship's bollard. In each of these cases the lecturer indicated the moulding conditions to be observed.

DISCUSSION.

THE BRANCH-PRESIDENT said Mr. Gallon had shown some of the senior members what they had missed, and had put a good deal of thought into his Paper. The lecturer seemed to have made a particular study of the educational question.

Education of Apprentices.

MR. W. RUTLEDGE said Mr. Gallon had dealt with one of the subjects which should have been taken up years ago. The foundry trade was one of the most skilful trades, and nobody was more conscious of the value of a good moulder than the draughtsman. He felt that the education of the apprentice-moulder had been neglected, not only by the education authorities but by the moulders themselves. Half the trouble with regard to classes for apprentices seemed to lie in the fact that the teacher often failed to hold the interest of the lads through not giving them the things they were interested in. What they wanted were practical moulders to volunteer to teach the boys, and it did not follow that a man who taught moulding would have to teach drawing and mathematics as well.

The northern counties were setting a standard of examinations for engineering and other trades, and if the foundry trade formed a scheme which they could submit to that board they would first of all impress all the northern counties, and then they would get a scheme started which would benefit the boys all over the country.

He (Mr. Rutledge) thought that the foundry trade was about the only trade that had not shown the interest in education that it ought to have done. If they could persuade the younger men to start a class for those living in the district, he personally would do all he could to help, because if the boys were encouraged to seek education it would be a great advantage to the trade and to the country.

A foundryman ought to know why a casting had to be a certain shape, and he would then be in a position to tell the draughtsman exactly what he wanted. It must be admitted that there were faults in the drawing office as well as anywhere else.

Junior Sections.

MR. H. J. YOUNG, F.I.C., said he was glad that Mr. Gallon had raised the question of education. The lecturer had missed one quotation, and, to the speaker's mind, it was the most important of all, namely, "You have to catch your hare before you can cook it." Many people in the Newcastle Branch had made schemes for young men, but the trouble was that they were unable to find the young men. They had a Junior Section in Newcastle, which had started quite successfully, but, unfortunately, the majority of the firms on Tyneside had done little or nothing to support it. At the last Surtees Examination there were, out of the whole North-East Coast, little more than a dozen boys entered for it. It is not the fault of the foundrymen that his education is being neglected, but that of the employers; unless the latter interest themselves in the education of their apprentices no progress can be made. It is useless going to the educational authorities, asking them to arrange classes, unless one can produce the boys. When they could do that, he was sure that the authorities would do their part. Foundry work was a dirty trade, and did not attract the best class of lad; nevertheless, the foundry apprentice ought to be encouraged to attend classes and meetings of the Junior Section.

It had been stated the boys in the foundry knew nothing about the metals they were using. Well, let them come to the Junior Section meetings, and they would soon be wiser. It was useless talking about what had not been done—it was up to them to support the schemes which had been formed and were in being. It was discouraging to hear people talking as if the Newcastle Branch of the Institute had not done its level best to help the foundry apprentice. The trouble was that the employers did not encourage the boys to seek education, and, therefore, one could not blame them if they did not do so.

Ineffective Compulsory Education.

MR. W. J. PAULIN said that what amused him about discussions of that nature was that the engineer was always getting the blame for something. Foundrymen apparently held the view that if a boy was good at his work he should be made an engineer. The trouble appeared to be that whereas the young engineer wanted education and scientific knowledge, the foundry apprentice never expressed a desire for it. He spoke strongly on that point, because to force a lad to attend classes never seemed, to his mind, to be very successful. He must admit that in the past there had been no attempt to arrange an attractive programme for the education of foundry workers. The foundryman and engineer were partners that could not be severed, but the thing which had to be considered was who would take the responsibility for the work?

Drawings seldom passed beyond the pattern-maker, and, therefore, rarely got into the hands of the moulder. It was one of those traditions which had been handed down. One must admit, however, that most drawings would be perfect puzzles to the average moulder, but, at the same time, simpler plans might be put into his hands.

Present System Criticised.

MR. R. WORDINGHAM said he was neither an engineer nor a moulder, but one interested in the education question. When a boy left school at fourteen years of age and started work he usually knew all about the geometry described by the lecturer. The last time he was at a meeting of the Newcastle Branch they were talking about schemes for the education of the foundry apprentice, but evidently not very much had matured. It seemed that the only thing to do in the case of small works was for four or five to combine together for the purpose of forming a class for the education of their boys.

An Appeal by the Juniors.

MR. H. F. CLEMENTS (Past-President of Junior Section) said he objected to the remark that nothing had been done towards the education of apprentices, but he wished to draw attention to the fact that a Junior Section had been formed for the benefit of those boys. The trouble lay in the fact that this scheme was not being supported as well as it might have been, and he appealed to the engineering firms on Tyneside to give their help by encouraging their boys to join. "We have done our bit, and we are waiting for them to back us up," he concluded.

MR. E. J. RANG (President of the Junior Section) remarked that the discussion seemed to have taken a different course from what the title of the Paper would have led one to expect. However, since the question of the education of apprentices was being discussed, he insisted that interest was the only factor upon which efficient education could be founded. The present-day school did very little to stimulate interest. For instance, an evening class would start at the beginning of the session with perhaps forty boys, and by Christmas it was no uncommon thing to find only twenty of them left, simply because the teacher had been unable to keep the interest of his class. Teaching was a gift which everyone did not possess, and however clever a man might be, it did not follow that he was able to impart that knowledge to others. It was the business of those arranging classes to find men who had the gift of teaching; in other words, men who could impart their knowledge to others.

They were doing their best to make their Junior Section a success, but they were not getting as good attendances at their meetings as they would like. He hoped the employers would do what they could to get their boys interested in the Junior Section.

The Author's Reply.

MR. GALLON, in reply, said he thought that Mr. Rutledge was the ideal lecturer to follow him and to complete the work of which he had tried to lay the foundation. He explained that he did not say that the foundryman should aim at becoming an engineer, but that he wanted him to become a better foundryman and more on equality with the engineer.

The engineer gave the patternmaker the credit of knowing a good deal about moulding, and why could he not give the moulder the credit of knowing something about pattern-making?

He thoroughly agreed with Mr. Wordingham's remarks, and thought it would be a splendid thing if there was a foundry on Tyneside where the lads could meet together and do test work. He felt sure that some of the members would be willing to give some time to teach these boys. In this way foundrymen would become more qualified to take their proper position in the engineering world.

Vote of Thanks.

MR. M. B. HERBST proposed a hearty vote of thanks to the lecturer, which MR. E. WOOD seconded. This was carried, and the meeting adjourned.

JUNIOR SECTION.

Discussion on Mr. F. Hudson's Paper on "High-Duty Cast Iron."*

THE PRESIDENT (Mr. E. S. Rang) remarked that it had always been a source of wonder to him that more people had not utilised the method of preheating the blast in the cupola because, from the lecturer's remarks, it appeared that this method resulted in considerable fuel economy. He did not know whether any attempt had been made to produce castings with a softer skin, but if this could be done it would be a great boon to engineers.

MR. DODDS asked whether the lecturer considered slow pouring to be better than quick pouring; also what did he think was a good blast pressure?

MR. V. L. BANKS said that to measure the air entering the cupola would be a difficult matter, because it depended upon the pressure of the air and also upon the velocity.

MR. C. R. VAN-DER-BEN asked if the lecturer did not think that hot blast in cupola practice was likely to produce soft iron. He would also like to know how Mr. Hudson measured his temperatures.

MR. W. P. GOSPEL (Secretary), referring to the preheating of blasts, said that there had been various devices brought out, but they did not seem to have been adopted by the average foundrymen, and he thought that the reason for this was that it did not pay. The lecturer had mentioned "Mayari" pig-iron, which contained chromium and nickel naturally formed from the ore. Did he think that if these alloys were added to an iron it would act the same purpose? The lecturer had stated that steel did not absorb carbon until the melting began, but he (the speaker) was of the opinion that carbon absorption commenced slightly before melting and just before the metal became spongy.

MR. J. W. FRIER said he was very interested in what Mr. Hudson had said about melting steel in the cupola, and he would like to know whether the lecturer had found much wear on the lining when melting. He would also like Mr. Hudson's advice as to where to get the best silica bricks for lining the cupola. He thought that bottom-pouring ladles were quite satisfactory if one had to make series of castings of a certain weight, otherwise it would mean having a lot of ladles. There was no doubt that the bottom-pouring ladle gave the cleanest metal. In conclusion, he said he thought it had been a most interesting lecture and that it should have been given to the Senior Branch.

The Author's Reply.

In reply to the President, MR. HUDSON said he was afraid that there would be hard skins on castings while they continued to be made in cold moulds. With slightly warm moulds one could reduce that hard skin a little. He was of the opinion that rather quick pouring was the better method, but thought that it was a point best left to the foreman moulder to judge from experience. The usual blast-pressure never exceeded 14 ozs. or 1 lb. Velocity and pressure of air were factors which must be considered quite separately. The pressure was measured by a pressure gauge and the velocity by some form of pitot tube.

In reply to Mr. Van-der-Ben, he did not think that there was very much difference between hot blast and cold blast iron. All casting temperatures were taken by a platinum phodium—platinum-thermo couple. The usual temperature for heavy work, such as cylinders, was about 1,350 deg. C., but for smaller jobs, the hotter the metal the better, and it was usually about 1,400 deg. C.

In reply to Mr. Gospel, he said that alloys could be added to the charge in the cupola and would have the same result, but it was more economical to buy irons containing them.

Replying to Mr. Frier, he said he thought that the best bricks for cupola lining were made by a well-known Sheffield concern, whose name he would communicate privately. For repairing the lining they themselves used a Durham brand of silica bricks.

Since they had adopted bottom-pouring ladles, about two or three years ago, not one casting had been rejected through dirt or scum getting into the mould. They had three of these ladles, which they used for cylinder castings, etc., but for special work an ordinary top-pouring ladle was used. He admitted that the amount of wear on the cupola lining, when melting steel, was very heavy, but for occasional melts it was quite successful.

* See the December 4 issue of the Journal.

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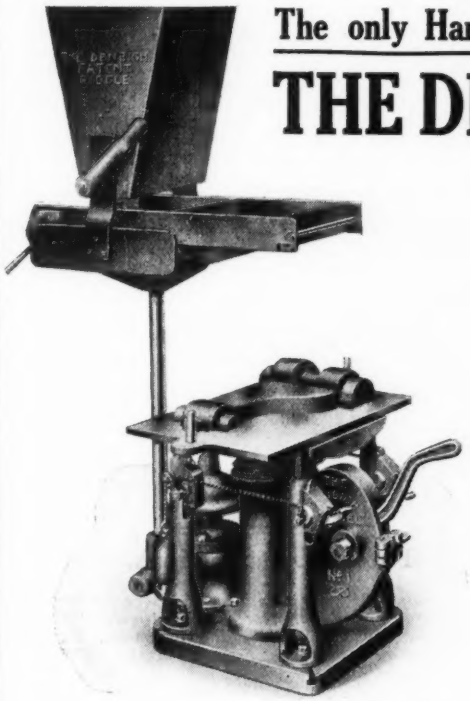

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IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH. — Christmastide celebrations having for the time being superseded business on Tees-side, markets for Cleveland iron have been practically closed during the current week, and only routine office work has claimed the attention of members, conditions likely to obtain until well into the new year. Home consumption of foundry iron meantime is on a very limited scale for the reasons above outlined, while the export trade, unfortunately, still continues to be on a disappointing scale, and everybody concerned is more or less marking time. There is still the currency handicap to Cleveland export trade, the franc having been again irregular, in spite of the steady rise in sterling. Prices, on the whole, may be pronounced steady, and there would seem to be little ground for any anticipation of lower values. Makers continue to quote No. 3 G.M.B. at 81s. 6d., No. 1 86s. 6d., No. 4 foundry 81s., and No. 4 forge 80s. per ton.

The hematite markets are without any noteworthy change, East Coast mixed numbers still standing at 88s. 6d. per ton, with North-West Coast quality of Bessemer mixed numbers quoted at 97s. 6d. per ton delivered at Glasgow, 102s. 6d. per ton delivered at Sheffield, and 107s. 6d. per ton delivered at Birmingham. Low-phosphorus iron is in fair request only.

LANCASHIRE.—The outlook as far as foundry iron is concerned in this area may be regarded as a little more promising, but until the holidays are over there will be few movements of importance in the market position. Meantime quotations for No. 3 quality pig may be taken as last reported.

THE MIDLANDS.—Business in South Staffordshire having closed down for the current week, the usual Thursday market was, of course, cancelled. With regard to quotations, the position of the Northants furnaces is much stronger than that of Derbyshire, the former being very well sold, and their figure of 76s. to 77s. for No. 3 foundry is quite firm, but although the Derbyshire price is nominally 82s. 6d. f.o.t., it is possible to get several brands below this, and 81s. 6d. is being taken for No. 3. There is no alteration in the North Staffs. quotation of 87s. 6d., and the makers in this area are well sold.

SCOTLAND.—The holidays in this district being held at the New Year, business in the Glasgow market is continued in the current week, but very little activity is observable on the part of either makers or consumers, while the price of No. 3 foundry remains unchanged at 90s. per ton at the furnaces, but merchants are in some cases prepared to shade this price for quick delivery.

Finished Iron.

There is no improvement to report in the Scottish finished iron trades. New business still remains scarce, but a much better tone prevails, and it is fully expected that conditions will be much altered in the early part of next year. Meantime, the works are a little better off for specifications owing to clearing off orders, prior to closing down at the end of the month.

Scrap.

Conditions in the scrap metal markets remain idle. On the North-East Coast, works are not at the moment offering more than 70s. per ton for heavy steel scrap, and holders are not inclined to sell at this figure. There is, however, rather more doing for machinery cast-iron scrap, 85s. per ton being obtainable for specially suitable material. Ordinary heavy cast is still quiet at 80s. There is only a moderate demand for piling iron, the price of which is unchanged at 92s. 6d. per ton. Bushelling scrap and cast-iron borings are lifeless and unchanged at the nominal figures of 80s. and 56s. per ton respectively. All these quotations include delivery at the works.

Metals.

Copper.—A steady advance in values has been a marked feature in movements in the standard copper market of late, and in view of the continued strength of latest American advices, the tendency is still towards a higher range of quotations. It is now generally admitted that consumers' demands on both sides of the Atlantic, and in Europe also, is on a steadily increasing scale, favouring the impression in market circles that more favourable conditions may be confidently anticipated after the resumption of business in the New Year.

Current quotations :—*Cash* : Thursday, £65 10s. ; Friday, £65 15s. ; Monday, £66 10s.

Three Months : Thursday, £66 12s. 6d. ; Friday, £66 17s. 6d. ; Monday, £67 10s.

Tin.—New York advices again report that markets for tin indicate more active conditions, consumers buying freely, while on this side there has been no outstanding change in the general conditions. Values, however, are fairly well maintained, fluctuations in quotations being confined within comparatively narrow compass, due in a measure, probably, more to holiday influences than a serious setback in the general position of the market.

Current quotations :—*Cash* : Thursday, £259 10s. ; Friday, £261 15s. ; Monday, £265 10s.

Three Months : Thursday, £263 ; Friday, £264 15s. ; Monday, £267 15s.

Spelter.—From New York reports come of a strong market consequent on a very heavy demand for export, and the strength affected values here to the extent of 20s. per ton for December shipment and 13s. 9d. per ton for March.

Current quotations :—*Ordinary* : Thursday, £37 5s. ; Friday, £37 5s. ; Monday, £37 17s. 6d.

Lead.—The market for soft foreign pig continues strong and active, with values maintained at the recent high figures previously reported.

Current quotations :—*Soft foreign (prompt)* : Thursday, £42 10s. ; Friday, £42 15s. ; Monday, £42 12s. 6d.

Patent Specifications.

Particulars of complete specifications accepted, furnished by Mr. Eric Potter, Patent Agent, of Lonsdale Chambers, 27, Chancery Lane, London, W.C.2. Printed copies of the specifications in the following list are now on sale.

218,254. KRUPP AKT-GES, F. Methods of making depressions in metal plates. June 25, 1923.

222,282. BUHLER, BROS. Device for adjusting the rollers in roller mills. September 22, 1923.

202,970. CONSTANT, G., and BRUZAC, A. Process of and apparatus for the reduction of metal oxides with continuous regeneration of the reducing-gas employed. August 22, 1922.

224,324. MACDONALD & SON, LIMITED, J., and NEESHAM, J. B. Foundry moulding machines. August 27, 1923.

224,330. THACKER, W. E. Machines for folding over the edges of sheet material. September 5, 1923.

224,365. STEWARTS & LLOYDS, LIMITED, and STEWART, J. G. Lining of iron and steel pipes and tubes. October 27, 1923.

224,420. HOLLEY, E. Process for coating metal moulds. January 25, 1924.

213,568. STIC, G., and STIC, E. Method for production of alloyed steel, and iron with chromium manganese molybdenum, tungsten, vanadium, etc. March 27, 1923.

224,534. BRITISH THOMSON HOUSTON COMPANY, LIMITED. Methods of treating metals. November 6, 1923.

224,622. SHAW, J. S. Furnaces for melting and refining glass. August 23, 1923.

224,625. MAES, G. L. V., and MAES, A. L. C. Machines for casting metals. August 23, 1923.

208,165. SOC. ALSACIENNE DE CONSTRUCTIONS MECANIQUES. Electric welding operations. December 8, 1922.

212,258. HOLLEY, E. Process for casting iron in permanent moulds at a regulated cooling rate. March 3, 1923.

224,788. JENKINS, W. Machine for separating metal sheets. March 14, 1924.

Standard Keys, Keyways and Key-bars.—The British Engineering Standards Association has just issued Publication No. 46, Part 1, 1924, British Standard Dimensions for Parallel Keys, Keyways and Key-bars. The tables have been extended to include keys for shafts down to 3-16th in. in diameter, the largest size still remaining at 12 in., and the shaft sizes have been divided into a greater number of ranges. The tables are accompanied by notes regarding the rounding of the corners of the keys and keyways, the depth of immersion, the fit of the keys in the keyways, etc. ; full dimensions of the keyway with tolerances are given, in addition to similar details for the key and key-bar, so that all information required for the production of interchangeable keys and keyways would seem to be provided. These tables form part of the general revision of Publication 46, 1909, with which the Committee is proceeding. The second and concluding part, it is hoped, will be issued early next year. Copies of the Publication (No. 46, Part I, 1924) may be obtained from the B.E.S.A., Publications Department, 28, Victoria Street, London, S.W.1. Price 1s. 2d. post free.

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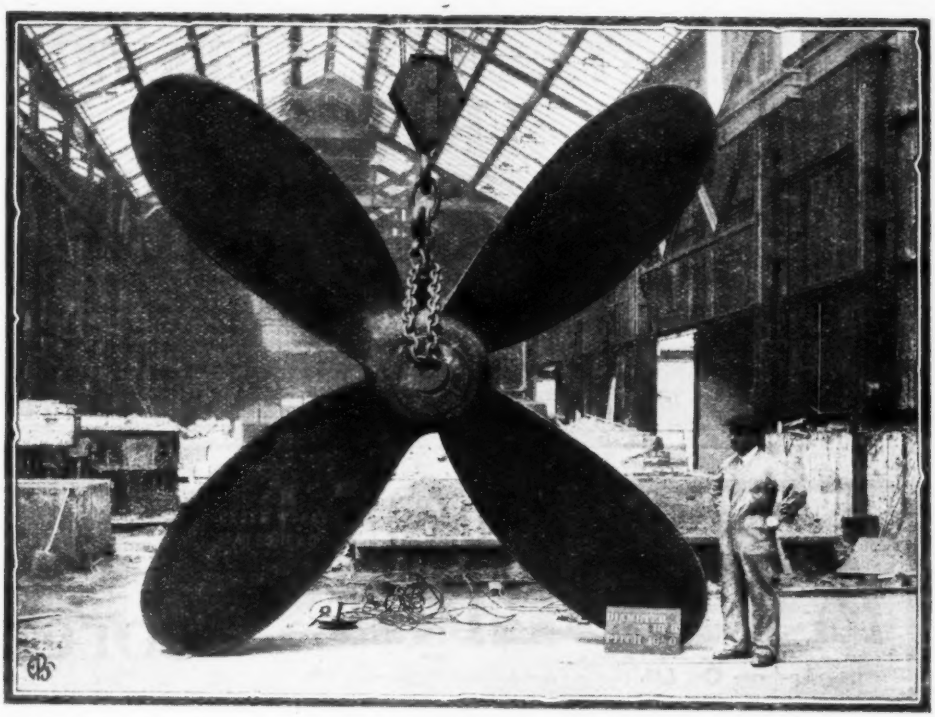

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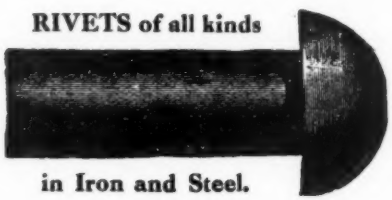

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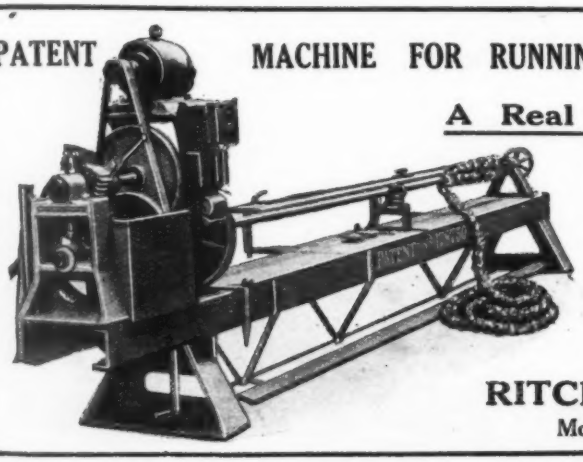

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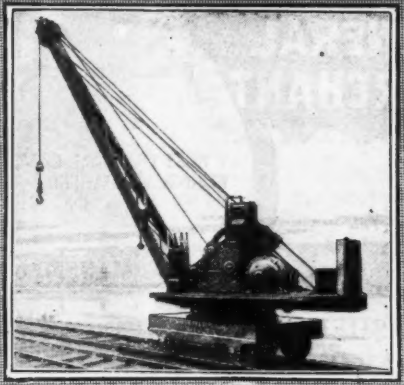

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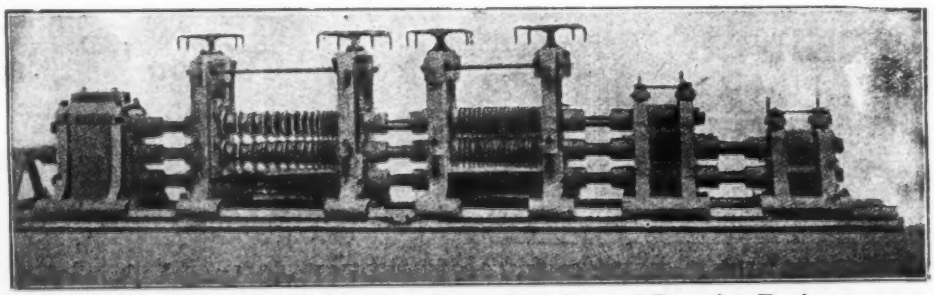

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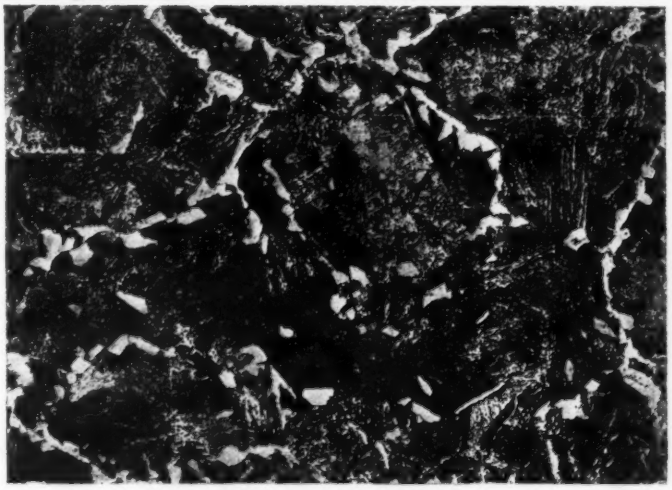

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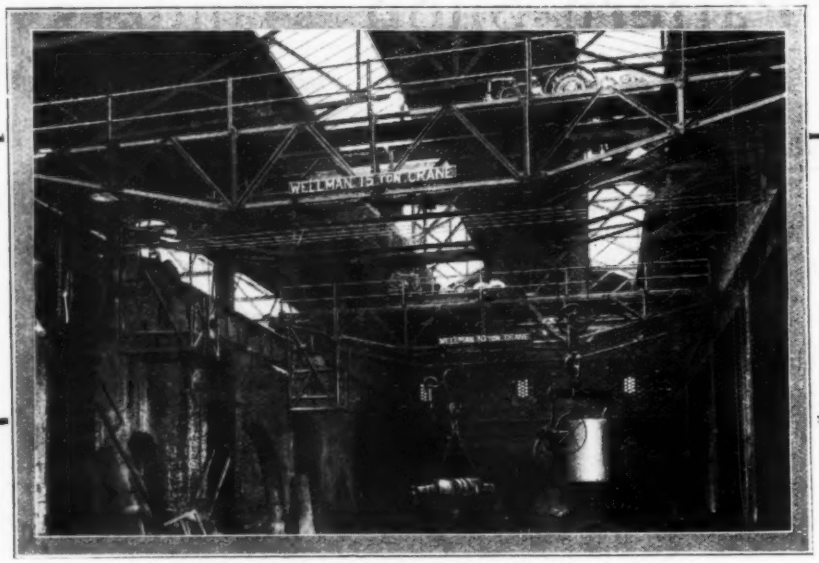
ELECTRIC CRANES



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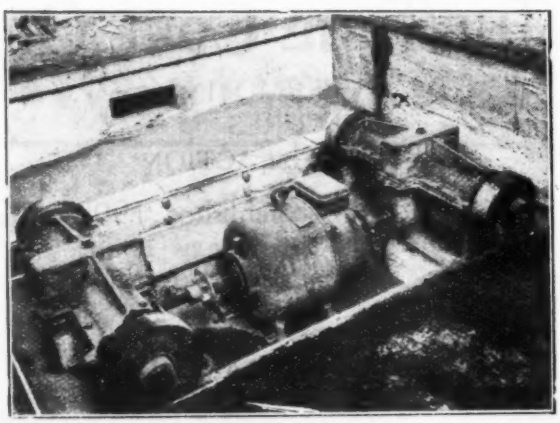

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B

The Refractory Philosopher

ventures to hope that all readers of this journal *really* will, *this* year, at any rate, enjoy

A Merry Christmas

—quiet, of course (as usual) but still, not without that good digestion that waits on appetite—and the wherewithal to assuage it.

AND the right company—for what saith the Poet—"A bottle of wine, a seven course dinner—and thou, beside me, in the easy chair—'twere Paradise enow." *And* again—"Better a dinner of herbs where love is, than a stalled ox, etc." *AND* let us not forget to throw off our anxious habit of business thought—our looking out for snags and squalls, our cautious precautions against a thousand things that never happen and wouldn't matter if they did, throw care to the dogs (who won't have it)—tune in the jolly old Savoy (via Chelmsford) shake a loose leg, and, for the Lord's sake, put on a beaming wide expansive

The Ref. Phr.—himself.

SMILE

AND KEEP IT ON

for what, again, saith the Poet—

"*Better a crowded hour of glorious life, than a year without a smile,*"

"*Laugh, and the world buys Compo from you—scowl, and they make their own.*"

So here's hoping and wishing and prophesying that 1925 may be the BOOMLET YEAR promised us, and that all our Customers, Agents, Representatives, Managers, past and prospective customers, competitors, alleged competitors, "silly seans," Refractarians, Keramicks, Journalistic friends—even the wireless "fans"

WILL HAVE A TIP-TOP NEW YEAR!

The General Refractories Co., Ltd., Sheffield and elsewhere.

Use Pressed Steel Moulding Boxes!

LIGHT, RIGID AND UNBREAKABLE

Made in all sizes and shapes to fit any job. Saves Sand and Labour.

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"COLTNESS" BRAND OF HIGH CLASS SCOTCH PIG IRON

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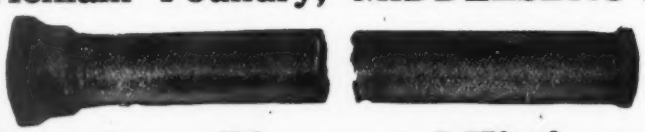
Acklam Foundry, MIDDLESBRO'.



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FLANGED
HYDRAULIC
VICTAULIC
FORSTER'S PATENT
JOINTS

Telegrams:
"RITCHIE, MIDDLESBROUGH."

OUR POST BAG

Out of courtesy we are replying to a number of letters the subject matter of which has no bearing on the competition, but for the future we must really request correspondents to limit their queries to the competition and to make their letters as short as possible. We would remind prospective letter writers that whilst we know quite a lot about Furnaces and their upkeep we are not experts on Cabbages, Wireless, Parrots, Roses, Onions, Illnesses, Dogs, Bowls, Solo and other kindred subjects.

Franz Bercovitch, London, E.	Oh yes, any British Foundryman may enter.
Gasproducer, Dudley Port	Of course it is. (2) We will reply to all your other queries when we reach the end of your letter.
Laboratory, Ipswich	Of course Chemists are eligible. *How* could good castings be made without *you*?
Worthing Willie, Sussex	So you're a Fretworker—work on Monday and fret the rest of the week, we presume.
Maudie, Nottingham	Thanks for photograph. Who said you aren't eligible?
Patternmaker, Bilston	Certainly. Send it up.
Obstinate, Derby	You wouldn't have "Silacene" as a gift. Quite right, you wouldn't—it's not given away.
Refractory Philosopher, Sheffield ..	No, you're not. Sorry.
Mrs. E., Southampton	Sorry to hear your husband died ten years ago. What a pity, he might have gone in for our competition.
Scotty, Aberdeen	Pleased to hear from you, but you might put a stamp on your envelope if you think of writing again.
Edgar, Bradford	The prize money will be paid in full. Who told you we should deduct 2d. for the cheque?
Artist, Chelsea	Elaborate setting out is not necessary. A straight line of words would win the prize, providing all commence with P, and the whole reads sense. But why worry, you're not a foundryman.
Grandfather, Wellington	What was good enough for your father is good enough for you—carry on old Bean.
Purchasing Agent, Dursley	Certainly you may enter. Send it up.
John, Northants	That's right, have a go at it. It's not Lent yet, you know.
Uncle Ben, Yorks	Sorry to hear you can't find your little nephew. Have you tried the dogs' home?
Furnaceman, Bedford	That's right. Slap it on.
Foundry Manager, Chesterfield	So that's your opinion. Anyway, it can't be worse than your writing. Perhaps you lack perspicacity.
Economy (Lincoln), M. A. (Maldon), Y. Z. (Hull), Satisfied (Bristol), E. V. (St. Helens), Glaze (Erith), and many others	Thanks for your kind baskets of fruit.
Cost Clerk, Sunderland	See reply to Purchasing Agent.
Fettler, Walsall	See reply to Patternmaker.
Silent Knight, Bournville	Yes, we remember you, but if Silence is Golden, then you must be a pauper.
Gladys and Violet, Leeds	Certainly Core makers are eligible.
Neutral, Holland	Need you ask. Britishers only in any case.
Storekeeper, Leicester	See reply to Patternmaker.
Friendly Disposed, Stockport	You may tell your friends that we are not in any Association or Combine. We do not believe in any arrangement which tends to keep up prices against the buyer.

A NUMBER OF REPLIES ARE UNAVOIDABLY HELD OVER.

THOS. E. GRAY & CO., LTD.,

The Makers of "SILACENE."

119, HIGH HOLBORN, LONDON, W.C.2.

ESTABLISHED 1877.

BE SURE YOU GET YOUR "F.T.J." NEXT WEEK.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	66	10	0
Three months	67	10	0
Electrolytic	70	15	0
Tough ..	68	10	0
Best selected	69	10	0
Sheets ..	96	0	0
India ..	86	0	0
Wire bars ..	70	10	0
Do. January	70	0	0
Do. February	70	0	0
Ingot bars ..	70	0	0
H.C. wire rods	74	0	0
Off. av. cash, Nov.	63	15	10½
Do., 3 mnths., Nov.	64	17	3
Do. Sttlmnt, Nov.	63	15	7½
Do., Electro, Nov.	68	5	7½
Do., B.S., Nov.	68	1	10½
Aver. spot price, copper, Nov.	63	15	7½
Do. wire bars, Nov.	68	10	0

Solid drawn tubes 13½d.
Brazed tubes .. 13½d.
Wire .. .. 10d.
Yellow metal rods 7½d.
Do. 4 x 4 Squares 8½d.
Do. 4 x 3 Sheets.. 9d.

BRASS.

Solid drawn tubes 12½d.
Brazed tubes .. 13½d.
Rods, drawn .. 11½d.
Rods, extruded or rolled 7½d.
Sheets to 10 w.g. 10½d.
Wire .. .. 10½d.
Rolled metal .. 10½d.

TIN.

Standard cash	265	10	0
Three months	267	15	0
English ..	267	0	0
Bars.. ..	269	0	0
Straits ..	268	5	0
Australian ..	266	17	6
Eastern ..	265	0	0
Banca ..	270	15	0
Off.aver.,cash, Nov.	257	17	0½
Do.,3mths., Nov.	260	13	7½
Do.Sttlmnt. Nov.	257	17	9
Aver. spot, Nov.	257	17	9

SPELTER.

Ordinary ..	37	17	6
Remelted ..	35	5	0
Hard ..	29	0	0
Electro 99.9 ..	42	12	6
English ..	38	0	0
India	30	5	0
Zinc dust ..	43	10	0
Zinc ashes ..	15	0	0
Off. aver., Nov.	34	17	7½
Aver., spot, Nov.	35	0	5½

LEAD.

Soft foreign ppt.	42	12	6
English ..	44	0	0
Off. average, Nov.	38	4	8½
Average, spot, Nov.	39	8	6

ZINC SHEETS, &c.

Zinc sheets, English	41	10	0
Do. V.M. ex. whf..	42	0	0
Dutch		—	
Rods	48	0	0
Boiler plates ..	40	10	0
Battery plates	40	0	0

ANTIMONY

Special brands, Eng.	69	10	0
Chinese ..	57	0	0
Crude	33	0	0

QUICKSILVER.

Quicksilver .. 12 0 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—
45/50% .. 11 17 6
75%.. .. 18 15 0
Ferro-vanadium—
35/40% .. 17/3 lb. va.
Ferro-molybdenum—
70/75% c. free 7/6 lb.
Ferro-titanium—
3/25% carbonless 1/1 lb.
Ferro-phosphorus, 20/25%, £27 0 0
Ferro-tungsten—
80/85%, c. free 1/4 to 1/4½ lb.
Tungsten metal powder—
98/99% .. 1/8 to 1/8½lb.
Ferro-chrome—
4/6% car. .. £23 17 6
6/8% car. .. £23 12 6
8/10% car... £23 5 0
Ferro-chrome—
Max. 2% car. £42 10 0
Max. 1% car. £51 10 0
Max. 0.70% car. £58 17 6
70%, carbonless 1/5½ lb.
Nickel—99%, cubes or pellets .. £165
Cobalt metal—98/99% 10/3 lb.
Aluminium 98/99% £130
Metallic Chromium—
96/98% .. 4/3 lb.
Ferro-manganese (net)—
76/80%, loose £15 10 0
76/80%, packed £16 10 0
76/80%, export £15 10 0
Metallic manganese—
94/96%, carbonless 2/3 lb.
Per ton, unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten ..	2	6
Finished bars, 18% tungsten ..	3	0

Per lb. net, d/d buyers' works.
Extras—
Rounds and squares 3 in. and over .. 4d. lb.
Rounds and squares under ½ in. to ¼in. 3d. lb.
Do. under ¼ in. to ⅛ in. .. 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¾ in. 3d. lb.
Do. under ½ in. × ¼in. 1/- lb.
Bevels of approved sizes and sections.. 6d. lb.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces .. 3d.
Turnings and swarf 1d.
Per lb. net, d/d steel makers' works.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	4	2	6 to	4	5	0
Bundled steel & shrngs.	3	12	6 to	4	0	0
Mixed iron & steel	3	10	0 to	3	13	6
Heavy cast iron	3	12	6 to	3	15	0
Good machinery for foundries ..		4	5	0		
Cleveland—						
Heavy steel ..		3	10	0		
Steel turnings ..		2	18	6		
Cast-iron borings		2	15	0		
Heavy forge ..		5	2	6		
Bushelled scrap..		4	0	0		
Cast-iron scrap ..		4	5	0		
Lancashire—						
Cast-iron scrap ..		4	0	0		
Heavy wrought..		4	0	0		
Steel turnings ..		3	0	0		

London — Merchants' buying prices delivered yard.

Copper (clean) ..	59	0	0
Brass (clean) ..	42	0	0
Lead (less usual draft)	38	0	0
Tea lead ..	34	10	0
Zinc	26	0	0
New aluminium cuttings.. ..	98	0	0
Braziery copper	52	0	0
Gunmetal ..	48	0	0
Hollow pewter ..	173	0	0
Shaped black pewter	106	0	0

PIG-IRON.

(*f.o.t. unless otherwise stated*)

N.E. Coast—
Foundry No. 1 .. 86/6
Foundry No. 3 .. 81/6
Forge No. 4 .. 80/–
Mottled .. .. —
Hematite No. 1 .. 89/–
Hematite M/Nos. .. 88/6
N.W. Coast—
Hem. M/Nos. d/d Glas. 99/–
„ d/d Birm. .. 107/6
Midlands—
Staffs. common* .. 102/–
„ No. 4 forge .. 80/–
„ No. 3 foundry 87/6
Shrops. basic .. 85/–
„ Cold blast,ord.* 190/–
„ „ roll iron* 195/–
* d/d Birmingham.
Northants forge .. 70/–
„ fdry. No. 3 .. 76/6
Derbyshire forge .. 75/–
„ fdry No. 3 .. 82/–
„ basic 82/6
Scotland—
Foundry No. 1 .. 95/–
„ No. 3 .. 90/–
Hem. M/Nos. .. 92/6
Sheffield (d/d district)—
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FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	12	0	0 to	13	0	0
Angles	12	15	0 to	13	15	0
Tees to 3 united ins.	13	10	0 to	14	10	0
Nut and bolt ..	11	15	0			
Hoops	14	0	0 to	15	0	0
Marked bars (Staffs.) f.o.t...	15	0	0			
Gas strip ..	13	5	0			
Bolts and nuts, ¾ in. × 4 in. ..	16	15	0			
Steel—						
Ship plates ..	9	15	0			
Boiler plts	13	0	0 to	13	10	0
Chequer plates ..	11	5	0			
Angles	9	5	0			
Tees	10	5	0			
Channels ..	8	12	6			
Joists	9	5	0			
Rounds & squares 3 in. to 5½ in...	9	15	0			
Rounds under 3 in. to ⅜ in. ..	9	10	0			
Flats, over 5 in. wide and up ..	10	5	0			
Flats, 5in. to 1½in.	9	5	0			
Rails, heavy ..	9	0	0			
Fishplates ..	13	0	0			
Hoops (Staffs.)	£11	0	0 to	12	0	0
Black sheets, 24 g.	12	12	6			
Galv. cor. sheets, 24 g.	17	10	0			
Galv. fencing wire 8 g. plain ..	15	0	0			
Billets,soft	£7	10	to 8	5	0	
Billets hard ..	9	5	0			
Sheet bars	£7	15/3	to 8	0	0	
Tin bars d/d (less rebate 7/6) ..	8	7	6			

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	2½
Sheet	1	3½
Wire	1	4½
Rods	1	3
Tubes	1	7½
Castings	1	2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	.. 9d. to 1/5½
Ingots rolled to spoon size	.. 1/– to 1/8½
Wire round—	
3/0 to 10 G.	.. 1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	24.51
No. 2 foundry, Valley	22.26
No. 2 foundry, Birm. ..	20.00
Basic	21.76
Bessemer	23.26
Malleable	22.26
Grey forge	21.76
Ferro-mang. 80% d/d	105.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess. billets ..	35.50
O.-h. billets	35.50
O.-h. sheet bars ..	37.00
Wire rods	48.00
	Cents.
Iron bars, Phila. ..	2.32
Steel bars	2.10
Tank plates	1.90
Beams, etc.	2.10
Skelp, grooved steel ..	2.00
Skelp, sheared steel ..	2.00
Steel hoops	2.50
Sheets, black, No. 28 ..	3.50
Sheets, galv., No. 28 ..	4.75
Sheets, blue an'l'd,9 & 10	2.70
Wire nails	2.85
Plain wire	2.60
Barbed wire, galv. ..	3.65
Tinplate, 100 lb. box ..	$5.50

COKE (at ovens).

Welsh foundry 37/6 to 42/6
„ furnace 27/6 to 35/–
Durham & North.
„ foundry 35/–
„ furnace 21/–
Other Districts, foundry 35/–
„ „ furnace .. 16/9

TINPLATES.

f.o.b. Bristol Channel ports.

I.C.Cokes,	20×14, box	23/6
„	28×20, „	47/–
„	20×10, „	34/3
„	18¾×14, „	24/3
C.W.	20×14, „	19/10½
„	28×20, „	44/4½
„	20×10, „	28/4½
„	18¾×14, „	20/7½

Terneplates 28×20,1/3 per box basis below tinplates.

SWEDISH IRON.

Bars, hammered £23/10to£24/5
Rolled Ord. £17/17/6 to £18/2/6
Nail rods .. £18/5 to £18/10
Keg. steel nom. £30 0
Faggot steel nom. £22 0
Blooms,Sngle weld.£10 to £12
Do. Single & double £13 to £14
Pig-iron £7 0 0 to £7 5 0
All f.o.b. Gothenburg.

TUBES.

	Up to and incl. 6 in.	
Gas	50%	Tube prices are now free.
Water	45%	
Steam	40%	

Electrolytic Copper.

	£	s.	d.	
Dec. 18	70	0	0	No change
„ 19	70	0	0	„ „
„ 22	70	15	0	inc. 15/–
„ 23	—			—
„ 24	—			—

Tin (English ingots).

	£	s.	d.	
Dec. 18	260	15	0	No change
„ 19	260	5	0	inc. 55/–
„ 22	267	0	0	„ 80/–
„ 23	—			—
„ 24	—			—

Spelter (ordinary).

	£	s.	d.	
Dec. 18	37	5	0	dec. 2/6
„ 19	37	5	0	No change
„ 22	37	17	6	inc. 12/6
„ 23	—			—
„ 24	—			—

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.	
Dec. 18	65	10	0	dec. 2/6
„ 19	65	15	0	inc. 5/–
„ 22	66	10	0	„ 15/–
„ 23	—			—
„ 24	—			—

Standard Tin (cash).

	£	s.	d.	
Dec. 18	259	10	0	dec. 20/–
„ 19	261	15	0	inc. 45/–
„ 22	265	10	0	„ 75/–
„ 23	—			—
„ 24	—			—

Zinc Sheets (English).

	£	s.	d.	
Dec. 18	41	10	0	inc. 10/–
„ 19	41	10	0	No change
„ 22	41	10	0	„ „
„ 23	—			—
„ 24	—			—

Lead (English).

	£	s.	d.	
Dec. 18	43	15	0	dec. 5/–
„ 19	44	0	0	inc. 5/–
„ 22	44	0	0	No change
„ 23	—			—
„ 24	—			—

HIGHEST AND LOWEST PRICES OF IRON AND STEEL AND METALS EVER TOUCHED.

	Lowest ever touched.				Highest ever touched.		
		£	s.	d.		£	s.	d.
Scotch No. 3	June, 1888	1	17	1	1920	13	10	0
Cleveland No. 3	July, 1888	1	10	11	1920	11	15	0
West Coast Hematite	June, 1888	2	0	8	1920	14	15	0
Northampton Forge, d/d S. Staffs.	May, 1886	1	14	0	1920	12	5	0
S.S. Marked bars	„ 1886	7	0	0	1920	33	10	0
S.S. Unmarked bars	June 1886	4	12	6	1920	30	0	0
Scotch bars	„ 1886	4	10	0	1920	30	0	0
Lancs. bars, Liverpool	„ 1886	4	12	6	1920	30	10	0
N.S. bars, Liverpool	„ 1886	4	12	6	1920	31	10	0
Galvanised Corr., 24 gauge, Liverpool	January, 1895	9	5	0	1920	55	10	0
Steel ship plates :—								
Scotch	April, 1895	5	0	0	1920	27	0	0
Middlesbro'	February, 1895	4	12	6	1920	24	10	0
Steel rails	April, 1896	3	10	0	1920	25	0	0
Tinplates (coke)	„ 1895	0	9	6	1920	3	18	0
Copper (standard)	June, 1894	37	17	6	1916	153	0	0
Tin (Foreign Straits)	„ 1894	52	10	0	1918	399	0	0
Spelter d/d S.S.	„ 1894	13	10	0	1915	115	0	0

AVERAGE MONTHLY PRICES OF EAST COAST HEMATITE AT MIDDLESBROUGH.

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1915	83 11	88 6	94 8	107 0	102 6	101 3	98 9	98 7½	96 6	104 0	124 1	130 0	106 11½
1916	133 9	140 0	136 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	128 1½
1917	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6
1918	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6
1919	122 6	122 6	122 6	122 6	179 2	190 0	197 6	200 0	200 0	200 0	200 0	200 0	171 4
1920	220 0	220 0	240 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	251 8
1921	240 0	220 0	180 0	180 0	180 0	160 0	160 0	160 0	137 0	127 6	117 6	104 6	162 2
1922	97 6	91 7½	100 0	98 6	97 1½	94 7	93 6	90 9	89 7	91 10½	93 0	93 2	94 5½
1923	94 6	104 9	122 0	126 10½	122 0	115 3	107 0	98 8½	98 10½	99 1½	100 6½	102 3	107 10½
1924	102 4½	101 3	99 7½	99 0	98 9½	97 4½	95 3½	93 1½	90 7½	87 7½	88 4½	88 6	95 2

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NON-FERROUS METALS

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ROYAL EXCHANGE, MIDDLESBROUGH.

93, HOPE STREET, GLASGOW.

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ENGINEER.—Practical, Technical, Commercial; good organiser; 47; thirty years' experience home and abroad; open to accept position as Export Manager, home; alternatively, Manager or Representative abroad.—Reply Box W. G. W., Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi Strand, London, W.C.2.

FOUNDRY MANAGER, energetic, experienced, would like to correspond with a Firm to whom his services would be useful; speciality—Internal Combustion Castings, Iron, Aluminium and Non-ferrous Alloys; references from two leading motor firms; Repetition Machine-moulded Castings a speciality.—Box 156, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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The Proprietors of the FOUNDRY TRADE JOURNAL have placed this space at the disposal of the District Director, 3-4, Clement's Inn, W.C., to whom all replies should be addressed, quoting number of advertisement, the date on which it appeared, and name of this paper.

EX-OFFICER, aged 32, single, 5 years' war service, educated public school, good knowledge of French, sound experience analysing oils, dyes, paints, zinc, colours, etc., technical and practical instructor and lecturer on construction, running, driving, overhauling I.C. engines vehicles, thorough knowledge of ball and roller bearings, able to write articles for publication, methods of advertising and publicity, thorough knowledge of office routine, book-keeping, able to organise and control, is willing to take any post. (10214.)

WORKS MANAGER, Foreman Millwright or Tool-room Engineer, age 40, good mechanical, electrical, practical and technical experience, 20 years superintendent, maintenance and production, designer of many improved methods of production and auto gear, thorough knowledge of all prime movers, machine tools, press work, etc., desires post as Superintendent, charge of plant, millwright foreman, tool-room foreman, or commercial, but is willing to take any post. (620/24.)

COMMERCIAL ENGINEER, ex-officer, age 32, married, 5 years' war service, educated public school, served regular apprenticeship mechanical engineering, good technical training, sound experience commercial engineering, established connection in Far East, contemplates making business trip to China and Japan, is prepared to represent or enter into Agency Agreement with a few firms and work on part expenses and commission basis; is also willing to accept any post. (1294/24.)

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PRACTICAL FOUNDRYMAN, with London Office, wishes representation of manufacturers of foundry equipment in London and South of England; A.M.I.B.F.—Box 154, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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THE PROPRIETOR of the Patent No. 2324 of 1912, for Improvements in Methods of Producing Wrought Shapes of Manganese Steel, is desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to: HASELTINE LAKE & Co., Chartered Patent Agents, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

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WRIGHT - MORGAN PIT-TYPE CRUCIBLE FURNACE, gas heated, with Crucible for 100 lbs. brass capacity; by Brayshaw Furnace and Tools, Ltd.; complete with No. 3 Rotary Blower, belt-driven; capacity, 3,500 cu. ft. per hour; never been used; cost £65; will accept nearest offer to £30 to clear.—DEXTER & Co. (HIGH WYCOMBE), LTD., The Foundry, High Wycombe.

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50 - ton HYDRAULIC TENSILE TESTING MACHINE, by J. Buckton & Co., Ltd.; with Hydraulic Accumulator, 3½-in. ram, and Belt-driven Hydraulic Pump.

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TWO FIRST-CLASS LOCOMOTIVES (Bagnalls); 2 ft. gauge; cyls., 9 in. x 12 in.

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EVERY FURNACE RELINED READY TO USE

BUY FROM ME & SAVE MONEY

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STANDARD GRADE 1/- lb.

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Loss in Ignition	3·05%
Silica	80·10%
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Alkalis	1·72%
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	99·95%

GREEN'S EMERGENCY CUPOLA IS A GREAT MONEY SAVER

Sizes from 5 to 40 cwts, capacity per hour.

GREEN'S STEEL CONVERTER PLANTS ARE SECOND TO NONE.

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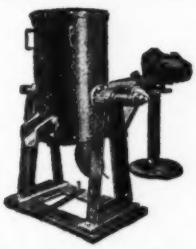

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Smelted alone gives good foundry iron.
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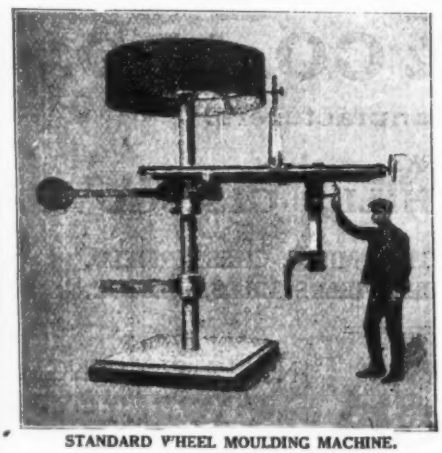

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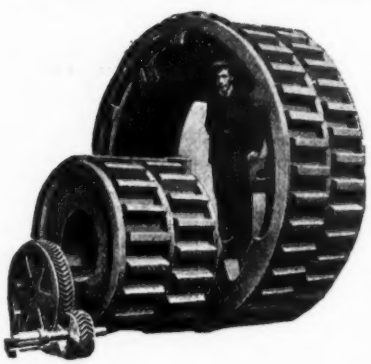

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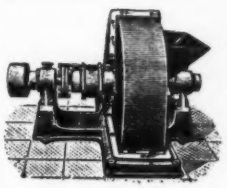
LOW power consumption.
CLEAN and sounder Castings, therefore a good investment.
CAPACITIES:
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Ask for Illustrated List.
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Russell Street, SHEFFIELD.

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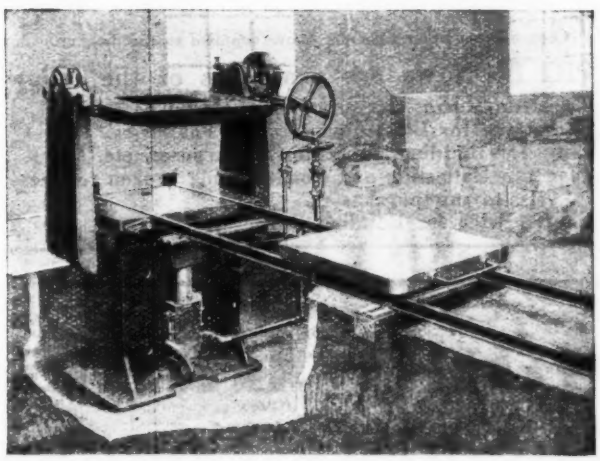
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Branch Office—
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Approximate Analyses of SHOTTS PIG IRON
FOUNDRY AND FORGE QUALITIES.

	Iron. %	Graphite Carbon. %	Combined Carbon. %	Silicon. %	Sulphur. %	Phos. %	Mang. %
No. 1	91.38	3.30	.25	3.25	.02	.70	1.10
No. 3 Soft	91.67	3.40	.20	2.90	.03	.70	1.10
No. 3 Medium	91.95	3.25	.35	2.60	.05	.70	1.10
No. 3 Hard	92.49	3.00	.45	2.30	.06	.70	1.00
No. 4 Soft	93.03	2.90	.50	1.80	.07	.70	1.00
No. 4 Hard	93.60	2.75	.65	1.40	.10	.70	.90
Mottled	93.95	2.00	1.50	.90	.15	.70	.80
White	94.35	.60	2.80	.55	.30	.70	.70

Compositions other than the above supplied to specification.

In addition to PIG IRON we are producers of the following:—
Coal for Steam, Gas and Household purposes.
Limestone for Blast Furnaces and Foundries.
Lime for Building, Agricultural Purposes, etc.
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Shotts Brick for Building Purposes.

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Steel Moulders' Composition,
Silica Bricks, Refractory Goods.

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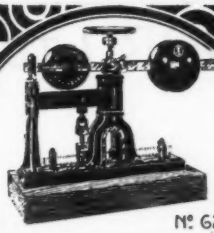

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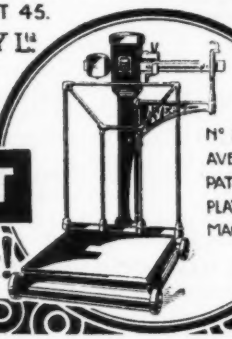

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Approximate Analyses.

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	Mottled and White
Combined Carbon	..	0.59 0.56	0.65 to 0.70	0.50 to 0.75	0.65 to 0.75	0.80	2.80 to 3.00
Graphite	..	2.94 2.96	2.85 to 2.94	2.70 to 2.80	2.60 to 2.70	2.00 to 2.40	Nil
Silicon	1.30	to 1.50	1.20 to 1.50	0.80 to 1.20	0.50 to 1.10	0.45 to 0.70	0.45 to 0.50
Sulphur	0.042	to 0.07	0.02 to 0.08	0.04 to 0.10	0.15 to 0.07	0.15 to 0.12	0.17 to 0.20
Phosphorus	..	—	0.35 to 0.45	0.35 to 0.50	0.35 to 0.50	0.35 to 0.50	0.35 to 0.50
Manganese	..	—	1.20 to 0.90	0.70 to 0.95	0.65 to 0.85	0.70 to 0.80	0.40 to 0.25

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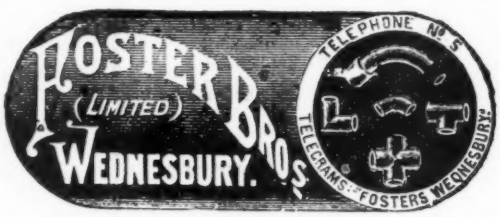

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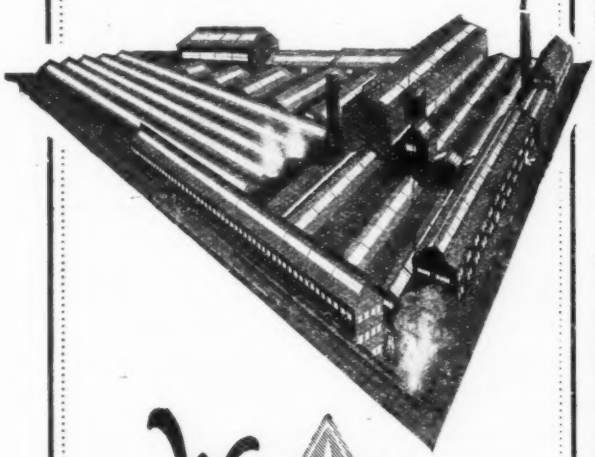

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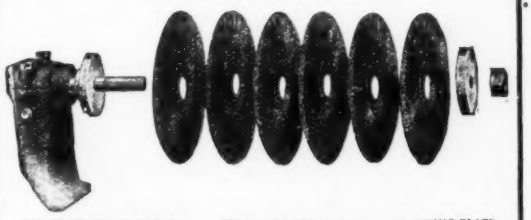

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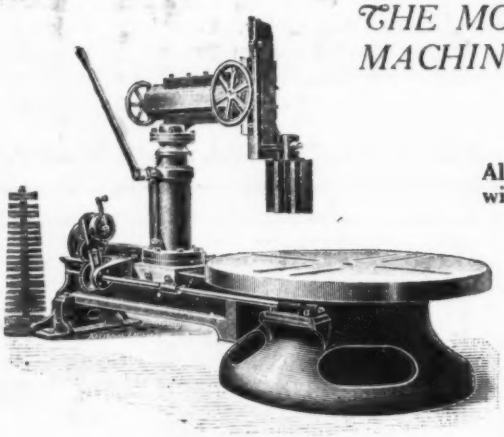

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HOME AND EXPORT.

Total number of Furnaces Built on June 30th, 1924	481
Total number of Furnaces in Blast on June 30th, 1924	190
Decrease in the number of Furnaces Built	3
Decrease in the number of Furnaces in Blast since March 31st, 1924	11

Furnaces Blown-in since March 31st, 1924 8

Scotland (2).—Glasgow Iron & Steel Co., Ltd., 1; Carron Co., 1.
Notts and Leicestershire (1).—Stanton Ironworks Co., Ltd., 1.
North Staffordshire (1).—Midland Coal, Coke & Iron Co., Ltd., 1.
Lancashire (2).—Barrow Hematite Steel Co., Ltd., 2.
Derby (1).—Clay Cross Co., 1.
Northamptonshire (1).—Lloyd's Ironstone Co., Ltd., 1.

Furnaces Blown-out since March 31st, 1924 19

Scotland (6).—Baird, Wm., & Co., Ltd., 6.
Durham and Northumberland (1).—Linthorpe Dinsdale Smelting Co., Ltd., 1.
Lincolnshire (4).—Appleby Iron Co., Ltd., 2; Redbourne Hill Iron Co., Ltd., 1; John Lysaght, Ltd., 1.
North Staffordshire (3).—R. Heath & Low Moor, Ltd., 1; Goldendale Iron Co., 1; Stafford Coal & Iron Co., Ltd., 1.
Lancashire (1).—Darwen & Mostyn Iron Co., Ltd., 1.
Northamptonshire (1).—Wellingboro' Iron Co., Ltd., 1.
South Staffordshire and Worcestershire (3).—G. & R. Thomas, 1; Alfred Hickman, Ltd., 1; Baldwins, Ltd., 1.

Furnaces being built at present time 4

(See below).

Furnaces being Re-lined at present time 66

Durham (6).—Consett Iron Co., Ltd., 3; Dorman, Long & Co., 1; Seaton Carew Iron Co., 2.
Cleveland (16).—Bolckow, Vaughan & Co., Ltd., 7; Cargo Fleet Iron Co., 1; Wm. Whitwell & Co., 1; Dorman, Long & Co., 2; Cochrane & Co., 2; Pease & Partners, 3.
South Staffordshire (2).—Alfred Hickman, 1; M. & W. Grazebrook, 1.
North Staffordshire (4).—Robert Heath & Low Moor, 2; Shelton Iron, Steel & Coal Co., 1; Stafford Coal & Iron Co., Ltd., 1.
Cumberland (6).—United Steel Companies (Workington), 4; Millom & Askam Hematite Iron Co., 1; Whitehaven Hematite Iron & Steel Co., Ltd., 1.
North Wales (2).—Darwen & Mostyn Iron Co., 2.
Lincolnshire (3).—Redbourne Hill Iron & Coal Co., 1; North Lincolnshire Iron Co., 1; John Lysaght, Ltd., 1.
Derbyshire (3).—Sheepbridge Coal & Iron Co., Ltd., 1; Clay Cross Co., 1; Denby Iron & Coal Co., 1.
Northamptonshire (1).—Kettering Iron & Coal Co., 1.
Lancashire (2).—North Lonsdale Iron & Steel Co., Ltd., 2.
Scotland (11).—Shotts Iron Co., 2; Dunlop, Jas., & Co., Ltd., 5; Coltness Iron Co., 1; Dixon, Ltd., 1; Glasgow Iron & Steel Co., 1; Summerlee Iron Co., Ltd., 1.
Shropshire (1).—Lilleshall Co., Ltd., 1.
South Wales (7).—Ebbw Vale Steel, Iron & Coal Co., Ltd., 2; Guest, Keen & Nettlefolds, Ltd., 3; Blaenavon Co., 1; Briton Ferry Works, Ltd., 1.
South and West Yorkshire (2).—Newton, Chambers & Co., 1; Walter Scott, Ltd., 1.

Scotland.

Name of Firm.	Total in blast on June 30.	In blast June 30 making: Hem.	Fgs. & F'dy.	Basic.	Average in blast: June qr.	Mar. qr.	Total built.	Fces relining
Langloan Iron and Chemical Co., Ltd., Coatbridge	—	—	—	—	—	—	5	—
Coltness Iron Co., Ltd., Coltness	4	2	2	—	4	4	9	1
Dixon, Wm., Ltd., Calder	—	—	—	—	—	—	7	—
Dixon, Wm., Ltd., Govan	2	2	—	—	2	2	6	1
Dunlop, Jas., & Co., Ltd., Tolcross	—	—	—	—	—	3	5	5
Glasgow Iron and Steel Co., Ltd., Wishaw	5	5	—	—	4½	4	6	1
Merry and Cuninghame, Ltd., Carnbroe	—	—	—	—	—	—	5	—
Shotts Iron Co., Ltd. ..	3	—	3	—	3	3	5	2
Summerlee Iron Co., Ltd. Coatbridge	4	—	4	—	4	4	7	1
Baird, Wm., & Co., Ltd., Gartsherrie	5	2	2	1	5	7	12	—
Baird, Wm., & Co., Ltd., Muirkirk	—	—	—	—	—	—	3	—
Baird, Wm., & Co., Ltd., Eglinton	2	—	2	—	2	6	6	—
Baird, Wm., & Co., Ltd., Lugar							5	
Dalmellington Iron Co., Ltd., Dalmellington	—	—	—	—	—	—	5	—
Merry & Cuninghame, Ltd., Ardeer	3	—	3	—	3	3	5	—

Cleveland District.

Name of Firm.	Total in blast on June 30.	In blast June 30 making: Hem.	Fgs. & F'dy.	Basic.	Average in blast: June qr.	Mar. qr.	Total built.	Fces relining
Dorman, Long & Co., Ltd., North Eastern Steel Works	2	—	2	—	2	2	4	1
Gjers, Mills & Co., Ltd.	2	2	—	—	2	2	5	—
Cargo Fleet Iron Co., Ltd.	2	—	—	2	2	2	3	1
Tees Furnace Co., Ltd., Lackenby	—	—	—	—	—	—	3	—
Bolckow, Vaughan & Co., Ltd.—								
Clay Lane	—	—	—	—	—	—	4	2
Cleveland, South Bank	3	—	3	—	3	3½	5	1
Cleveland Steel Works, Eston	—	—	—	—	—	—	2	1
Middlesbrough ..	—	—	—	—	—	—	2	1
South Bank	3	—	2	—	3	3	4	—
Grangetown ..	—	—	—	—	—	—	2	2
Linthorpe - Dinsdale Smelting Co., Ltd. (Linthorpe Iron Works)	—	—	—	—	—	1½	6	2
Dorman, Long & Co., Ltd., Newport Iron-works	3	1	2	—	3	3	7	1
Pease & Partners, Ltd., Normanby Iron Works	2	2	—	—	2	2	3	1
Cochrane & Co., Ltd.	1	—	1	—	1	1	3	2
Dorman, Long & Co., Ltd. Redcar Ironworks	3	—	—	3	3	3	6	—
Pease & Partners, Ltd.,	4	—	4	—	4	4	5	1

Northamptonshire.

Name of Firm.	Total in blast on June 30.	In blast June 30 making: Hem.	Fgs. & F'dy.	Basic.	Average in blast: June quarter	Mar. quarter	Total built.	Fces relining
New Cransley Iron Co...	1	—	1	—	1	1	2	—
Hunsbury Iron Co., Hunsbury Furnaces, Northampton	—	—	—	—	—	—	2	—
United Steel Companies, Ltd, Wellingboro'	1	—	1	—	1	1	4	—
Islip Iron Co., Ltd., Thrapston	2	—	2	—	2	2	4	—
Kettering Iron and Coal Co., Ltd., Kettering	2	—	2	—	2	2	3	1
Wellingboro' Iron Co., Ltd., Wellingboro'	1	—	1	—	2	1½	3	—
Lloyd's Ironstone Co., Ltd.	3	—	2	1	2½	2	3	—
Totals	10	—	9	1	10½	9½	21	1

South Staffordshire and Worcestershire

T. & I. Bradley, Ltd. (Capponfield)	—	—	—	—	—	—	2	—
Bradley & Foster, Ltd., Darlaston	—	—	—	—	—	—	2	—

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PLASTIC SILICA
CEMENT
The Most Durable for Melting Furnaces.
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Baird, Wm., & Co., Ltd., Lugar	[illegible]						5	
Dalmellington Iron Co., Ltd., Dalmellington	—	—	—	—	—	—	6	—
Merry & Cuninghame, Ltd., Ardeer	3	—	3	—	3	3	5	—
David Colville & Sons, Ltd., Glengarnock	4	—	3	1	4	4	7	—
Carron Co., Carron	3	—	3	—	5	2½	4	—
Totals	35	11	22	2	36½	42½	102	11

North Wales.

Brymbo Steel Co., Ltd.	1	—	—	1	1	1	1	—
Darwen & Mostyn Iron Co., Ltd., Mostyn	*2	—	—	—	3	2	3	2
Totals	3	—	—	1	4	3	4	2

*Two furnaces making ferro-manganese, etc.

South Wales & Mon.

Briton Ferry Works, Ltd., Briton Ferry	1	1	—	—	1	1	2	1
Baldwins, Ltd., Cwmavon Works, Glamorgan	—	—	—	—	—	—	2	—
Baldwins, Ltd., Swansea Hematite Works, Landore	—	—	—	—	—	—	2	—
Baldwins, Ltd., Margam	2	—	—	2	2	2	2	—
Crawshay Bros. (Cyfarthfa), Ltd.	—	—	—	—	—	—	5	—
Guest, Keen & Nettlefolds, Ltd., Dowlais	2	2	—	—	2	1½	4	1
Guest, Keen & Nettlefolds, Ltd., Cardiff	1	1	—	—	1	1	4	2
Guest, Keen & Nettlefolds, Ltd. (Cwmbran, Mon.)	—	—	—	—	—	—	1	—
Blaenavon Co., Ltd., Blaenavon	2	2	—	—	1½	1½	3	1
Ebbw Vale Steel, Iron and Coal Co., Ltd.	3	2	—	1	3	3	9	2
Fyfe & Blaina Works, Ltd.	—	—	—	—	—	—	2	—
Totals	11	8	—	3	10½	10	36	7

Durham and Northumberland.

Dorman, Long & Co., Ltd., Carlton Iron Works	*1	—	—	—	1	1	3	1
Dorman, Long & Co., Ltd., Clarence Works	3	—	—	3	3	3	11	—
Consett Iron Co., Ltd., Blackhill	4	4	—	—	4	4	8	3
Palmers Shipbuilding and Iron Co., Ltd., Jarrow	—	—	—	—	—	—	5	—
Linthorpe-Dinsdale Smelting Co., Ltd., Middleton	†2	—	—	—	2½	3	4	—
Seaton Carew Iron Co., Ltd., West Hartlepool	2	1	—	1	2	2	4	2
Pease & Partners, Ltd., Tees-Bridge Iron Wks.	2	—	2	—	2	2	3	—
Weardale Steel, Coal and Coke Co., Ltd., Tudhoe Furnaces, Spennymoor	—	—	—	—	—	—	2	—
Totals	14	5	2	4	14½	15	40	6

*One furnace making ferro-manganese, etc.
†Two furnaces ditto.

Lincolnshire.

Appleby Iron Co., Ltd., Frodingham	2	—	—	2	4	4	4	—
Frodingham Iron and Steel Co., Ltd., Doncaster	3	—	—	3	3	3	4	—
Redbourn Hill Iron and Coal Co., Ltd.	2	—	—	2	2	3	4	1
North Lincolnshire Iron Co., Ltd., Scunthorpe	2	—	—	2	2	2	3	1
Trent Iron Co., Ltd., Scunthorpe	2	—	—	2	2	2	3	—
John Lysaght, Ltd., Normanby Park Steelworks, Scunthorpe	4	—	—	4	4½	4½	5	1
Totals	15	—	—	15	17½	18½	23	3

Notts. and Leicestershire.

Bestwood Coal and Iron Co., Ltd., near Nottingham	2	—	2	—	2	2	4	—
Stanton Ironworks Co., Ltd., Asfordby	4	—	4	—	4	3	4	—
Totals	6	—	6	—	6	5	8	—

Shropshire.

Madeley Wood Co. ..	—	—	—	—	—	—	3	—
Lilleshall Co., Ltd. ..	2	—	1	1	2	2	3	1
Totals	2	—	1	1	2	2	6	1

Pease & Partners, Ltd., Normanby Iron Works	2	2	—	—	2	2	3	1
Cochrane & Co., Ltd. ..	1	—	1	—	1	1	3	2
Dorman, Long & Co., Ltd. Redcar Ironworks	3	—	—	3	3	3	6	—
Pease & Partners, Ltd., Skinningrove	4	—	4	—	4	4	5	1
Pease & Partners, Ltd., Tees Ironworks	2	2	—	—	2	2	3	1
W. Whitwell & Co., Ltd.	2	2	—	—	2	2	3	1
Totals ..	29	9	14	5	29	32	70	16

NOTE:—Basic heading includes furnaces making Cleveland pig-iron for steel-making purposes.
* One furnace making ferro-manganese, etc.

West Cumberland.

United Steel Companies, Ltd., Harrington, Derwent Solway, Moss Bay, Workington	*6	5	—	—	5½	5½	18	4
Distington Hematite Iron Co., Ltd. ..	—	—	—	—	—	—	3	—
Millom & Askam Hematite Iron Co., Ltd., Millom	1	1	—	—	1	1	6	1
Whitehaven Hematite Iron & Steel Co., Ltd.	1	1	—	—	1	1	3	1
Totals	8	7	—	—	7½	7½	30	6

* One furnace making ferro-manganese, etc.

North Staffordshire.

Midland Coal, Coke and Iron Co., Ltd., Apedale	2	—	1	1	2	1	5	—
R. Heath & Low Moor, Ltd., Stoke	1	—	—	1	1	2	6	2
Goldendale Iron Co. ..	—	—	—	—	—	1	2	—
Stafford Coal and Iron Co., Ltd.	2	—	2	—	2	3	4	1
Shelton Iron, Steel and Coal Co., Ltd., Stoke	2	—	—	2	2	2	4	1
Totals	7	—	3	4	7	9	21	4

South and West Yorkshire.

Walter Scott, Ltd., Leeds Steelworks	2	—	1	1	2	2	4	1
R. Heath & Low Moor, Ltd.	*1	—	1	—	1	1	2	—
Parkgate Iron and Steel Co., Ltd.	2	—	—	2	2	2	3	—
Newton, Chambers & Co., Ltd., Sheffield	2	—	2	—	2	2	3	1
Yorks Iron and Coal Co., Ltd., Leeds	2	—	2	—	2	2	4	—
Wm. Woodhead & Son, Ltd., Bradford	—	—	—	—	—	—	1	—
Totals	9	—	6	3	9	9	17	2

*Cold Blast.

Lancashire.

Millom & Askam Co., Ltd., Askam	—	—	—	—	—	—	1	—
Charcoal Iron Co., Ulverston (Backbarrow)	1	1	—	—	1	1	1	—
Barrow Hematite Steel Co., Ltd.	2	2	—	—	2	2	7	—
Carforth Hematite Iron Co., Ltd., Carnforth	1	1	—	—	1	1	3	—
Darwen & Mostyn Iron Co., Ltd., Darwen	—	—	—	—	1	1	2	—
Wigan Coal and Iron Co., Ltd.	†2	—	—	1	2	2	5	—
North Lonsdale Iron and Steel Co., Ltd.	1	1	—	—	1	1½	4	2
Partington Steel & Iron Co., Ltd., Irlam, near Manchester	3	—	—	3	3	3	6	—
Totals	10	5	—	4	9½	11½	29	2

† One furnace making ferro-manganese, etc.

Derbyshire.

Stanton Ironworks Co., Alfreton	2	—	2	—	2	2	3	—
Butterley Co., Ltd., Alfreton (Butterley Wks.)	—	—	—	—	—	—	2	—
Clay Cross Co.	2	—	2	—	2	1	3	1
Denby Iron and Coal Co.	2	—	2	—	2	2	4	1
Bennerley Iron Coy., Ltd., Bennerley	2	—	2	—	2	2	3	—
Ditto, Erewash ..	—	—	—	—	—	—	2	—
Renishaw Iron Co., Ltd., Chesterfield	1	—	1	—	1	1	1	—
Sheepbridge Coal and Iron Co., Ltd.	2	—	2	—	2	2	4	1
Staveley Coal and Iron Co., Ltd., Staveley and Devonshire Works	6	—	6	—	6	6	11	—
Stanton Ironworks Co.	8	—	8	—	8	8	9	—
Totals	25	—	25	—	25	24	42	3

T. & I. Bradley, Ltd. (Capponfield)	—	—	—	—	—	—	2	—
Bradley & Foster, Ltd., Darlaston	—	—	—	—	—	—	2	—
G. & R. Thomas, Hathercon	—	—	—	—	—	1	2	—
Earl of Dudley, Brierley Hill	1	—	*1	—	1	1	4	—
N. Hingley & Sons, Ltd., Dudley	1	—	1	—	1	1	2	—
Alfred Hickman, Ltd. ..	3	—	—	3	3½	4½	5	1
Willingsworth Iron Co., Ltd., Wednesbury	—	—	—	—	—	—	2	—
M. & W. Grazebrook, Ltd., Dudley	1	—	1	—	1	1	2	1
Cochrane & Co., Dudley	—	—	—	—	—	—	2	—
Baldwins, Ltd. (Netherton Furnaces)	—	—	—	—	—	1	2	—
Wm. Roberts (Tipton), Ltd.	—	—	—	—	—	—	3	—
The Birchill's Furnaces, Ltd., Walsall	—	—	—	—	—	—	2	—
Totals	6	—	3	3	6½	9½	30	2

*Cold Blast.

Gloucester, Somerset, and Wilts.

New Westbury Iron Co., Ltd.	—	—	—	—	—	—	2	—
Totals ..	—	—	—	—	—	—	2	—
GRAND TOTALS FOR UNITED KINGDOM .	190	45	91	46	196½	208½	481	66

New Furnaces Building (4).

DERBYSHIRE (1):—Renishaw Iron Co. Ltd., 1.
LINCOLNSHIRE (2):—Appleby Iron Co., 2.
NOTTS AND LEICESTERSHIRE (1):—Stanton Ironworks Co., Ltd., 1.

Number of Furnaces in Blast on June 30, 1924.

District.	Average in blast for Quarter.	Total in blast on June 30, 1924.	Total in blast on June 30 making		
			Hem.	Forge & Forge.	Basic.	Ferro-Man. &c.
Scotland	36½	35	11	22	2	—
Durham and Northumberland	14½	14	5	2	4	3
Cleveland	29	29	9	14	5	1
Northamptonshire	10½	10	—	9	1	—
Lincolnshire	17½	15	—	—	15	—
Derbyshire	25	25	—	25	—	—
Notts and Leicestershire ..	6	6	—	6	—	—
S. Staffordshire & Worcestershire	6½	6	—	3	3	—
North Staffordshire	7	7	—	3	4	—
West Cumberland	7½	8	7	—	—	1
Lancashire	9½	10	5	—	4	1
South Wales & Mon.	10½	11	8	—	3	—
South and West Yorkshire	9	9	—	6	3	—
Shropshire	2	2	—	1	1	—
North Wales	4	3	—	—	1	2
Gloucester, Somerset, and Wilts. ..	—	—	—	—	—	—
Totals	196½	190	45	91	46	8
Totals for Previous Quarter ..	208½	201	45	94½	51½	10

Average Number of Furnaces in Blast for the previous Six Quarters.

District.	Mar. 1924.	Dec. 1923.	Sept. 1923.	June, 1923.	Mar. 1923.	Dec. 1922.
Scotland	42½	43½	43½	46½	39½	32
Durham and Northumberland	15	12½	11½	14	11½	8½
Cleveland	32	28½	32½	34	32½	24½
Northamptonshire ..	9½	9	9	9½	10	9½
Lincolnshire	18½	17	17	18	14	11
Derbyshire	24	23½	23½	24	19½	17
Notts and Leicestershire	5	5	5	5	4½	3
S. Staffordshire and Worcestershire	9½	8	7½	10	7	6½
North Staffordshire ..	9	8½	8	11	10	9
West Cumberland ..	7½	8	8	11½	11	9½
Lancashire	11½	12½	11	14	12	10½
South Wales & Mon. ..	10	11½	9	10½	8	7
South and West Yorkshire	9	7½	7½	8½	8	7
Shropshire	2	2	2	2	1½	1
North Wales	3	3	3	3	3	2
Gloucester, Somerset and Wilts.	—	—	—	—	—	—
Totals	208½	199½	198	222	191½	157½

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September 30th, 1924.

BLAST FURNACES OF THE UNITED KINGDOM

BUILT AND IN BLAST.

Compiled from Returns Received Direct from the Furnaces, and Published at the Offices of

BESSEMER HOUSE, 5, DUKE STREET, ADELPHI, LONDON, W.C. 2
Telegrams—ZACATECAS, WESTRAND, LONDON. Telephone—GERRARD 6611 (2 Lines).

THE FOUNDRY TRADE JOURNAL, WITH WHICH IS INCORPORATED THE IRON & STEEL TRADES JOURNAL.

These Statistics have been published regularly each Quarter since 1879.

BESSEMER HOUSE, 5, DUKE STREET, ADELPHI, LONDON, W.C. 2
Telegrams—ZACATECAS, WESTRAND, LONDON. Telephone—GERRARD 6611 (2 Lines).

Total number of Furnaces Built on September 30th, 1924	474
Total number of Furnaces in Blast on September 30th, 1924	172
Decrease in the number of Furnaces Built	7
Decrease in the number of Furnaces in Blast since June 30th, 1924	18
Furnaces Blown-in since June 30th, 1924	6

Cleveland (2).—Dorman, Long & Co., Ltd., Newport Ironworks, 1; Cochrane & Co., Ltd., 1.
North Staffordshire (1).—Goldendale Iron Co., 1.
Derbyshire (1).—Stanton Ironworks Co., 1.
South Staffordshire and Worcestershire (2).—G. & R. Thomas, Hatherton, 1; Alfred Hickman, Ltd., 1.

Furnaces Blown-out since June 30th, 1924 24

Scotland (5).—Shotts Iron Co., Ltd., 2; Merry & Cuninghame, 3.
North Wales (2).—Brymbo Steel Co., Ltd., 1; Darwen & Mostyn Iron Co., Ltd., Mostyn, 1.
South Wales and Mon. (1).—Blaenavon Co., Ltd., Blaenavon, 1.
Durham and Northumberland (1).—Dorman, Long & Co., Ltd., Carlton Iron Works, 1.
Lincolnshire (4).—Redbourne Hill Iron & Coal Co., Ltd., 2; North Lincolnshire Iron Co., Ltd., Scunthorpe, 2.
Cleveland (2).—Gjers, Mills & Co., Ltd., 2.
North Staffordshire (2).—Stafford Coal & Iron Co., Ltd., 2.
South and West Yorkshire (3).—R. Heath & Low Moor, Ltd., 1; Parkgate Iron & Steel Co., Ltd., 2.
Lancashire (1).—Charcoal Iron Co., Ulverston (Backbarrow), 1.
Northamptonshire (1).—Lloyd's Ironstone Co., Ltd., 1.
South Staffordshire and Worcestershire (2).—Earl of Dudley, Brierley Hill, 1; N. Hingley & Sons, Ltd., Dudley, 1.

Furnaces being built at present time 4

(See below).

Furnaces being Re-lined at present time 64

Durham (6).—Consett Iron Co., Ltd., 3; Dorman, Long & Co., 1; Seaton Carew Iron Co., 2.
Cleveland (15).—Bolckow, Vaughan & Co., Ltd., 8; Cargo Fleet Iron Co., 1; Wm. Whitwell & Co., 1; Cochrane & Co., 1; Pease & Partners, 3; Gjers, Mills & Co., Ltd., 1.
South Staffordshire (2).—Alfred Hickman, 1; M. & W. Grazebrook, 1.
North Staffordshire (5).—Robert Heath & Low Moor, 2; Shelton Iron, Steel & Coal Co., 1; Stafford Coal & Iron Co., Ltd., 1; Goldendale Iron Co., 1.
Cumberland (7).—United Steel Companies (Workington), 4; Millom & Askam Hematite Iron Co., 1; Whitehaven Hematite Iron & Coal Co., Ltd., 1; Distington Hematite Iron Co., Ltd., 1.
North Wales (2).—Darwen & Mostyn Iron Co., 2.
Lincolnshire (2).—Redbourne Hill Iron & Coal Co., 1; John Lysaght, Ltd., 1.
Derbyshire (2).—Sheepbridge Coal & Iron Co., Ltd., 1; Stanton Ironworks Co., Alfreton, 1.
Northamptonshire (2).—Kettering Iron & Coal Co., 1; Islip Iron Co., Ltd., Thrapston, 1.
Lancashire (3).—North Lonsdale Iron & Steel Co., Ltd., 2; Charcoal Iron Co., Ulverston (Backbarrow), 1.
Scotland (9).—Shotts Iron Co., 2; Dunlop, Jas., & Co., Ltd., 4; Coltness Iron Co., 1; Dixon, Ltd., 1; Glasgow Iron & Steel Co., 1.
South Wales (8).—Ebbw Vale Steel Iron & Coal Co., Ltd., 2; Guest, Keen & Nettlefolds, Ltd., 3; Blaenavon Co., 2; Briton Ferry Works, Ltd., 1.
South and West Yorkshire (1).—Newton, Chambers & Co., 1.

Scotland.

Name of Firm.	Total in blast on Sept. 30.	In blast Sept. 30 making: Hem.	Fgs. & F'd'y.	Basic.	Average in blast: Sept. qr.	June qr.	Total built.	Fnces relining
Langloan Iron and Chemical Co., Ltd., Coatbridge	—	—	—	—	—	—	5	—
Coltness Iron Co., Ltd., Coltness	4	2	2	—	4	4	9	1
Dixon, Wm., Ltd., Calder	—	—	—	—	—	—	7	—
Dixon, Wm., Ltd., Govan	2	2	—	—	2	2	6	1
Dunlop, Jas., & Co., Ltd., Torrens	—	—	—	—	—	—	5	4
Glasgow Iron and Steel Co., Ltd., Wishaw	5	5	—	—	5	4½	6	1
Merry and Cuninghame, Ltd., Carnbroe	—	—	—	—	—	—	5	—
Shotts Iron Co., Ltd. ..	1	—	1	—	½	3	5	2
Summerlee Iron Co., Ltd. Coatbridge	4	—	4	—	4	4	7	—
Baird, Wm., & Co., Ltd., Gartsherrie	5	2	3	—	5	5	12	—
Baird, Wm., & Co., Ltd., Muirkirk	—	—	—	—	—	—	3	—
Baird, Wm., & Co., Ltd., Eglinton	2	—	2	—	2	2	6	—
Baird, Wm., & Co., Ltd., Lugar							5	
Dalmellington Iron Co., Ltd., Dalmellington	—	—	—	—	—	—	5	—
Merry & Cuninghame, Ltd., Ardeer	—	—	—	—	3	5	—	—
David Colville & Sons, Ltd., Glengarnock	4	—	3	1	4	4	7	—
Carron Co., Carron	3	—	3	—	3	5	4	—
Totals	30	11	18	1	29½	30½	102	9

Cleveland District.

Name of Firm.	Total in blast on Sept. 30.	In blast Sept. 30 making: Hem.	Fgs. & F'd'y.	Basic.	Average in blast: Sept. qr.	June qr.	Total built.	Fnces relining
Dorman, Long & Co., Ltd., North Eastern Steel Works	2	—	2	—	2	2	4	—
Gjers, Mills & Co., Ltd.	—	—	—	—	1½	2½	5	1
Cargo Fleet Iron Co., Ltd.	2	—	—	2	2	2½	5	1
Tees Furnace Co., Ltd., Lackenby	—	—	—	—	—	—	3	—
Bolckow, Vaughan & Co., Ltd.—								
Clay Lane	—	—	—	—	—	—	4	3
Cleveland, South Bank	3	—	3	—	3	3	5	1
Cleveland Steel Works, Eston	—	—	—	—	—	—	5	1
Middlesbrough ..	—	—	—	—	—	—	2	1
South Bank	3	—	3	—	3	3	4	1
Grangetown ..	—	—	—	—	—	—	2½	2
Linthorpe - Dinsdale Smelting Co., Ltd. (Linthorpe Iron Works)	—	—	—	—	—	—	6	—
Dorman, Long & Co., Ltd., Newport Ironworks	4	2	1	1	3½	3	7	—
Pease & Partners, Ltd., Normanby Iron Works	2	2	—	—	2	2	3	1
Cochrane & Co., Ltd. .	2	1	1	—	2	1	3	1
Dorman, Long & Co., Ltd. Redcar Ironworks	3	—	—	3	3	3	6	—
Pease & Partners, Ltd., Skinningrove	4	—	4	—	4	4	5	1
Pease & Partners, Ltd., Tees Ironworks	2	2	—	—	2	2	3	1
W. Whitwell & Co., Ltd	2	2	—	—	2	2	3	1

Northamptonshire.

Name of Firm.	Total in blast on Sept. 30.	In blast Sept. 30 making: Hem.	Fgs. & F'd'y.	Basic.	Average in blast: Sept. quarter	June quarter	Total built.	Fnces relining
New Cransley Iron Co.	1	—	1	—	1	1	2	—
Hunsbury Iron Co., Hunsbury Furnaces, Northampton	—	—	—	—	—	—	2	—
United Steel Companies, Ltd., Wellingboro'	1	—	1	—	1	1	4	—
Islip Iron Co., Ltd., Thrapston	2	—	2	—	2	2	4	1
Kettering Iron and Coal Co., Ltd., Kettering	2	—	2	—	2	2	3	1
Wellingboro' Iron Co., Ltd., Wellingboro'	1	—	1	—	1	2	3	—
Lloyd's Ironstone Co., Ltd.	2	—	1	1	2½	2½	3	—
Totals	9	—	8	1	9½	10½	21	2

South Staffordshire and Worcestershire.

Name of Firm.	Total in blast on Sept. 30.	In blast Sept. 30 making: Hem.	Fgs. & F'd'y.	Basic.	Average in blast: Sept. quarter	June quarter	Total built.	Fnces relining
T. & I. Bradley, Ltd. (Capponfield)	—	—	—	—	—	—	2	—
Bradley & Foster, Ltd., Darlaston	—	—	—	—	—	—	2	—
G. & R. Thomas, Hatherton	1	—	1	—	½	—	2	—
Earl of Dudley, Brierley Hill	—	—	—	—	—	1	4	—

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Baird, Wm., & Co., Ltd., Lugar							(5	
Dalmellington Iron Co., Ltd., Dalmellington	—	—	—	—	—	—	5	—
Merry & Cuninghame, Ltd., Ardeer	—	—	—	—	—	3	5	—
David Colville & Sons, Ltd., Glengarnock	4	—	3	1	4	4	7	—
Carron Co., Carron	3	—	3	—	3	5	4	—
Totals	30	11	13	1	20½	36½	102	9

North Wales.

Brymbo Steel Co., Ltd.	—	—	—	—	½	1	1	—
Darwen & Mostyn Iron Co., Ltd., Mostyn	*1	—	—	—	1	3	3	2
Totals	1	—	—	—	1½	4	4	2

* One furnace making ferro-manganese, etc.

South Wales & Mon.

Briton Ferry Works, Ltd. Briton Ferry	1	1	—	—	1	1	2	1
Baldwins, Ltd., Cwmavon Works, Glamorgan	—	—	—	—	—	—	2	—
Baldwins, Ltd., Swansea Hematite Works, Landore	—	—	—	—	—	—	2	—
Baldwins Ltd., Margam	2	—	—	2	2	2	2	—
Guest, Keen & Nettlefolds, Ltd., Dowlais	2	2	—	—	2	2	4	1
Guest, Keen & Nettlefolds, Ltd., Cardiff	1	1	—	—	1	1	4	2
Guest, Keen & Nettlefolds, Ltd. (Cwmbran, Mon.)	—	—	—	—	—	—	1	—
Blaenavon Co., Ltd., Blaenavon	1	1	—	—	1	1½	3	2
Ebbw Vale Steel, Iron and Coal Co., Ltd.	3	3	—	—	2½	3	9	2
Tyle & Blaina Works, Ltd.	—	—	—	—	—	—	2	—
Totals	10	8	—	2	9½	10½	31	8

Durham and Northumberland.

Dorman, Long & Co., Ltd., Carlton Iron Works	—	—	—	—	½	1	3	1
Dorman, Long & Co., Ltd., Clarence Works	3	—	—	3	3	3	11	—
Consett Iron Co., Ltd., Blackhill	4	4	—	—	4	4	8	3
Palmers Shipbuilding and Iron Co., Ltd., Jarrow	—	—	—	—	—	—	5	—
Linthorpe-Dinsdale Smelting Co., Ltd., Middleton	†2	—	—	—	2	2½	4	—
Seaton Carew Iron Co., Ltd., West Hartlepool	2	1	—	1	2	2	4	2
Pease & Partners, Ltd., Tees-Bridge Iron Wks.	2	—	2	—	2	2	3	—
Totals	13	5	2	1	13½	14½	38	6

† Two furnaces making ferro-manganese, etc.

Lincolnshire.

Appleby Iron Co., Ltd., Frodingham	2	—	—	2	2	4	4	—
Frodingham Iron and Steel Co., Ltd., Doncaster	3	—	—	3	3	3	4	—
Redbourn Hill Iron and Coal Co., Ltd.	—	—	—	—	2	2	4	1
North Lincolnshire Iron Co., Ltd., Scunthorpe	—	—	—	—	2	2	3	—
Trent Iron Co., Ltd., Scunthorpe	2	—	—	2	2	2	3	—
John Lysaght, Ltd., Normanby Park Steelworks, Scunthorpe	4	—	—	4	4	4½	5	1
Totals	11	—	—	11	15	17½	23	2

Notts. and Leicestershire.

Bestwood Coal and Iron Co., Ltd., near Nottingham	2	—	2	—	2	2	4	—
Stanton Ironworks Co., Ltd., Ashfordby	4	—	4	—	4	4	4	—
Totals	6	—	6	—	6	6	8	—

Shropshire.

Madeley Wood Co. ..	—	—	—	—	—	—	3	—
Ollerbarrow Co., Ltd. ..	2	—	1	1	2	2	3	—
Totals	2	—	1	1	2	2	6	—

Pease & Partners, Ltd., Normanby Iron Works	2	2	—	—	2	2	5	1
Cochrane & Co., Ltd. ..	2	1	1	—	2	1	3	1
Dorman, Long & Co., Ltd. Redcar Ironworks	3	—	—	3	3	3	6	—
Pease & Partners, Ltd., Skinningrove	4	—	4	—	4	4	5	1
Pease & Partners, Ltd., Tees Ironworks	2	2	—	—	2	2	3	1
W. Whitwell & Co., Ltd	2	2	—	—	2	2	3	1
Totals ..	29	9	14	6	30	29	70	15

NOTE:—Basic heading includes furnaces making Cleveland pig-iron for steel-making purposes.

West Cumberland.

United Steel Companies, Ltd., Harrington, Derwent Solway, Moss Bay, Workington,	*6	5	—	—	5½	5½	18	4
Distington Hematite, Iron Co., Ltd. ..	—	—	—	—	—	—	3	1
Millom & Askam Hematite Iron Co., Ltd., Millom	1	1	—	—	1	1	6	1
Whitehaven Hematite Iron & Steel Co., Ltd.	1	1	—	—	1	1	3	1
Totals	8	7	—	—	7½	7½	30	7

* One furnace making ferro-manganese, etc.

North Staffordshire.

Midland Coal, Coke and Iron Co., Ltd., Apedale	2	—	1	1	2	2	5	—
R. Heath & Low Moor, Ltd., Stoke	1	—	1	—	1	1	6	2
Goldendale Iron Co. ..	1	—	1	—	½	—	2	1
Stafford Coal and Iron Co., Ltd.	—	—	—	—	—	2	4	1
Shelton Iron, Steel and Coal Co., Ltd., Stoke	2	—	—	2	2	2	4	1
Totals	6	—	3	3	5½	7	21	5

South and West Yorkshire.

Walter Scott, Ltd., Leeds Steelworks	2	—	2	—	2	2	4	—
R. Heath & Low Moor, Ltd.	—	—	—	—	—	1	2	—
Parkgate Iron and Steel Co., Ltd.	—	—	—	—	1½	2	3	—
Newton, Chambers & Co., Ltd., Sheffield	2	—	2	—	2	2	3	1
Yorks Iron and Coal Co., Leeds	2	—	2	—	2	2	4	—
Wm. Woodhead & Son, Ltd., Bradford	—	—	—	—	—	—	1	—
Totals	6	—	6	—	7½	9	17	1

Lancashire.

Millom & Askam Co., Ltd., Askam	—	—	—	—	—	—	1	—
Charcoal Iron Co., Ulverston (Backbarrow)	—	—	—	—	1	1	1	1
Barrow Hematite Steel Co., Ltd.	2	2	—	—	2	½	7	—
Carnforth Hematite Iron Co., Ltd., Carnforth	1	1	—	—	1	1	3	—
Darwen & Mostyn Iron Co., Ltd., Darwen	—	—	—	—	—	1	2	—
Wigan Coal and Iron Co., Ltd.	†2	—	—	1	2	2	5	—
North Lonsdale Iron and Steel Co., Ltd.	1	1	—	—	1	1	4	2
Partington Steel & Iron Co., Ltd., Irlam, near Manchester	3	—	—	3	3	3	6	—
Totals	9	4	—	4	10	9½	29	3

† One furnace making ferro-manganese, etc.

Derbyshire.

Stanton Ironworks Co. Alfreton	2	—	2	—	2	2	3	1
Butterley Co., Ltd., Alfreton (Butterley Wks.)	—	—	—	—	—	—	2	—
Clay Cross Co. ..	2	—	2	—	2	2	3	—
Denby Iron and Coal Co.	2	—	2	—	2	2	4	—
Bennerley Iron Coy., Ltd., Bennerley	2	—	2	—	2	2	3	—
Ditto, Erewash ..	—	—	—	—	—	—	2	—
Renishaw Iron Co., Ltd., Chesterfield	1	—	1	—	1	1	1	—
Sheepbridge Coal and Iron Co., Ltd.	2	—	1	1	2	2	4	1
Staveley Coal and Iron Co., Ltd., Staveley and Devonshire Works	6	—	6	—	6	6	11	—
Stanton Ironworks Co.	9	—	9	—	9	8	9	—
Totals	26	—	25	1	26	25	42	2

T. & I. Bradley, Ltd. (Capponfield)	—	—	—	—	—	—	2	—
Bradley & Foster, Ltd., Darlaston	—	—	—	—	—	—	2	—
G. & R. Thomas, Hatherton	1	—	1	—	½	—	2	—
Earl of Dudley, Brierley Hill	—	—	—	—	—	1	4	—
N. Hingley & Sons, Ltd., Dudley	—	—	—	—	—	1	2	—
Alfred Hickman, Ltd. ..	4	—	—	4	2	3½	5	1
Willingsworth Iron Co., Ltd., Wednesbury	—	—	—	—	—	—	2	—
M. & W. Grazebrook, Ltd., Dudley	1	—	1	—	1	1	2	1
Cochrane & Co., Dudley	—	—	—	—	—	—	2	—
Baldwins, Ltd. (Netherton Furnaces)	—	—	—	—	—	—	2	—
Wm. Roberts (Tipton), Ltd.	—	—	—	—	—	—	3	—
The Birchill's Furnaces, Ltd., Walsall	—	—	—	—	—	—	2	—
Totals	6	—	2	4	3½	6½	30	2

Gloucester, Somerset, and Wilts.

New Westbury Iron Co., Ltd.	—	—	—	—	—	—	2	—
Totals ..	—	—	—	—	—	—	2	—
GRAND TOTALS FOR UNITED KINGDOM .	172	44	85	38	176½	196½	474	64

New Furnaces Building (4).

DERBYSHIRE (1):—Renishaw Iron Co, Ltd., 1.
LINCOLNSHIRE (2):—Appleby Iron Co., 2.
NOTTS AND LEICESTERSHIRE (1):—Stanton Ironworks Co., Ltd., 1.

Number of Furnaces in Blast on Sept. 30, 1924.

District.	Average in blast for Quarter.	Total in blast on Sept. 30, 1924	Total in blast on Sept. 30 making: Hem	Cge. & Forge.	Basic	Ferro-Man., etc.
Scotland	29½	30	11	18	1	—
Durham and Northumberland ..	13½	13	5	2	4	2
Cleveland	30	29	9	14	6	—
Northamptonshire	9½	9	—	8	1	—
Lincolnshire	15	11	—	—	11	—
Derbyshire	26	26	—	25	1	—
Notts and Leicestershire ..	6	6	—	6	—	—
S. Staffordshire & Worcestershire ..	3½	6	—	2	4	—
North Staffordshire	5½	6	—	3	3	—
West Cumberland	7½	8	7	—	—	1
Lancashire	10	9	4	—	4	1
South Wales & Mon.	9½	10	8	—	2	—
South and West Yorkshire ..	7½	6	—	6	—	—
Shropshire	2	2	—	1	1	—
North Wales	1½	1	—	—	—	1
Gloucester, Somerset, and Wilts. ..	—	—	—	—	—	—
Totals	176½	172	44	85	38	5
Totals for Previous Quarter ..	196½	190	45	91	46	8

Average Number of Furnaces in Blast for the previous Six Quarters.

District.	June, 1924.	Mar. 1924.	Dec. 1923.	Sept. 1923.	June, 1923.	Mar. 1923
Scotland	36½	42½	43½	43½	46½	39½
Durham and Northumberland	14½	15	12½	11½	14	11½
Cleveland	29	32	28½	32½	34	32½
Northamptonshire ..	10½	9½	9	9	9½	10
Lincolnshire	17½	18½	17	17	18	14
Derbyshire	25	24	23½	23½	24	19½
Notts and Leicestershire	6	5	5	5	5	4½
S. Staffordshire and Worcestershire	6½	9½	8	7½	10	7
North Staffordshire ..	7	9	8½	8	11	10
West Cumberland ..	7½	7½	8	8	11½	11
Lancashire	9½	11½	12½	11	14	12
South Wales & Mon. ..	10½	10	11½	9	10½	8
South and West Yorkshire	9	9	7½	7½	8½	8
Shropshire	2	2	2	2	2	1½
North Wales	4	3	3	3	3	3
Gloucester, Somerset and Wilts.	—	—	—	—	—	—
Totals	196½	208½	199½	198	222	191½

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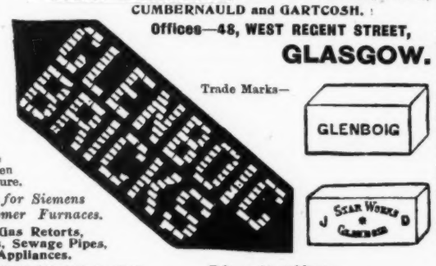

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